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THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

VOLUME I

1916-'17

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Gainesville, Fla.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the act of June 6, 1900.

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Published by
STATE PLANT BOARD OF FLORIDA
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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. I OCTOBER, 1916 No. 1

CITRUS CANKER INVESTIGATIONS

WILMON NEWELL

One of the first steps taken by the State Plant Board upon the passage of the Florida Plant Act of 1915 was to make provision for an exhaustive study of citrus canker with a view to determining whether any remedial measures for this destructive disease of citrus trees might be devised.

The establishment of a special laboratory for these investigations was made possible by the generosity and public spirit of the South Dade County Fruit and Truck Growers' Association. This association erected at Redland, Dade County, a spacious building to be used jointly as an auditorium and a laboratory. For the latter the State Plant Board purchased the necessary equipment and the Tropical Laboratory was formally opened on November 27, 1915, with Dr. R. A. Jehle, Assistant Plant Pathologist, in charge. Considerable difficulty was experienced in getting the necessary laboratory supplies on account of the unsettled European conditions, but good progress in the investigations has nevertheless been made.

It was early recognized that the fruit growers and inspectors should be provided with descriptions and illustrations of citrus canker in order that they might recognize the disease and distinguish it from other diseases attacking citrus, as the first step towards its eradication.

As a result of careful studies of this disease upon various citrus host plants, Dr. Jehle has prepared the article and illustrations which appear upon the following pages. These, it is believed, will be of great interest and value in the fight now being waged against this disease.

Inasmuch as the laboratory was located in south Dade County, many of the specimens selected for purposes of illustration were, in view of the necessity for accurate identification, selected in the adjacent localities. They were, however, typical of canker specimens found from time to time in other sections of the State where citrus canker exists. It was perhaps fortunate that the

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preparation of these illustrations was among the first work undertaken at the laboratory, for eradication of the disease in that section, thanks to the hearty co-operation of the great majority of growers, has progressed so rapidly that canker-infected trees are now found only by means of the closest and most efficient inspection.

Other investigations under way at the laboratory are expected to yield information which will materially aid in the practical work of eradicating this disease. The results of these investigations will appear in the Quarterly Bulletin as rapidly as they can be completed.

MEANS OF IDENTIFYING CITRUS CANKER

R. A. JEHLE

Citrus canker is one of the most destructive diseases of citrus plants, and if allowed to develop unchecked it threatens to greatly cripple, if not to completely destroy, the citrus industry wherever it occurs, and especially where the climate is warm and moist during part or all of the year. The disease has only been known to science for about three years and, according to all available information, was introduced into the Gulf States from Japan. It is very important for every grower of citrus plants to be familiar with its characteristics so that it may be eradicated as quickly as possible when found.

PLANTS KNOWN TO BE AFFECTED.

Citrus canker has been found on almost all kinds of citrus plants, and it is likely that none of them is immune, altho they vary in their susceptibility. Observations of Berger (1914) seem to indicate that they are susceptible in the following order: grapefruit, *Citrus trifoliata*, Key lime, navel orange, sweet orange, satsuma, tangerine, mandarin, king orange and lemon. Altho the kumquat was at first thought to be immune (Berger, 1914), recent observations have shown that under favorable conditions it is also susceptible. Wolf (1916) states that it has been observed on this host in Louisiana, and Swingle (1915) reports its occurrence on kumquat in Japan. The writer has produced citrus canker on the kumquat and other citrus plants in Florida by inoculating healthy trees with the canker organisms

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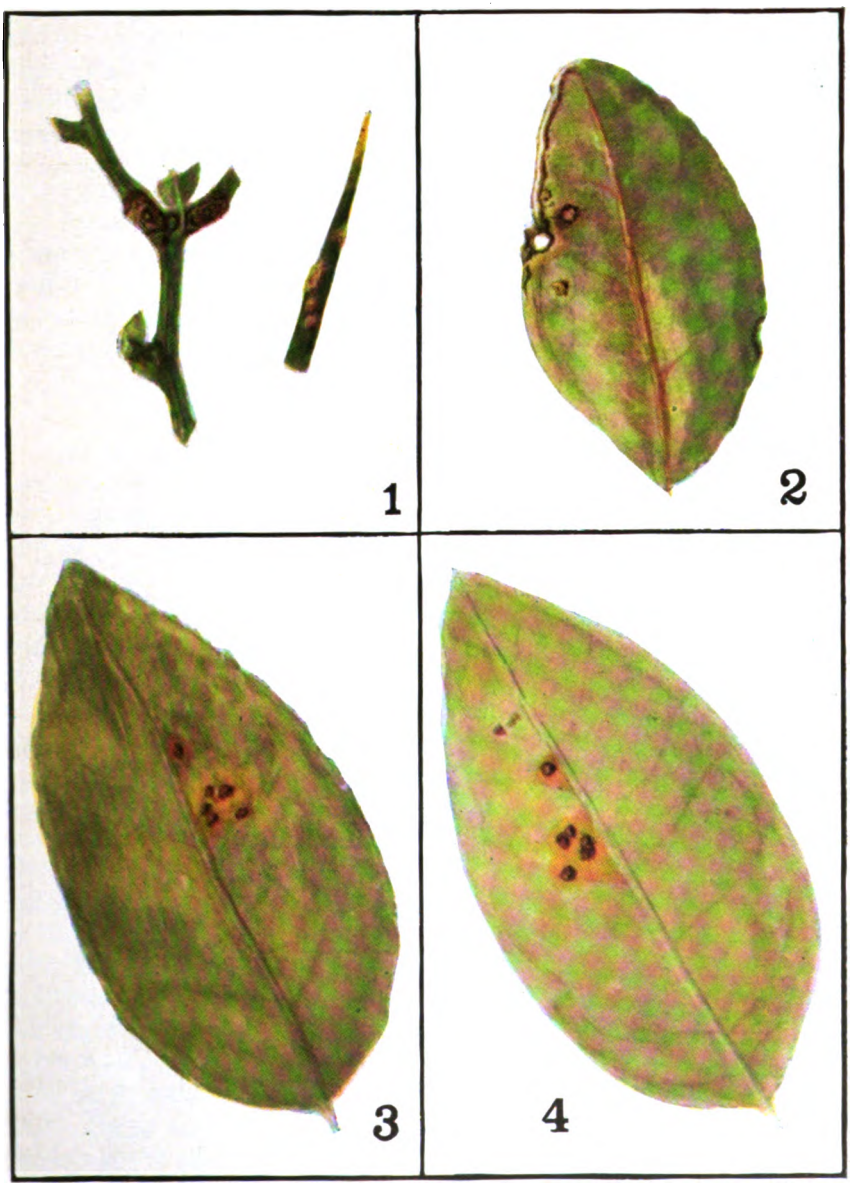

Figure 1. Canker on twig and thorn of lime. Natural size. Collected in South Dade County. Figure 2. Canker on under surface of lime leaf. Natural size. Collected in South Dade County. Figure 3. Very young canker on upper surface of lime leaf. Natural size. Collected in South Dade County. Figure 4. Lower surface.

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(*Pseudomonas citri* Hasse). The following citrus plants have been infected in this way: grapefruit, tangelo, ponderosa lemon, sour orange, sweet orange, mandarin lime, king orange, and kumquat.

CHARACTERISTICS OF THE DISEASE.

According to Stevens (1915) any part of the plant above ground may become infected. The writer has observed citrus canker on the leaves, young twigs, thorns, older limbs one inch or less in diameter, green fruit and ripe fruit. The older limbs do not seem to be as susceptible as the leaves, twigs and fruit.

ON THE LEAVES.

Medium sized, thrifty leaves seem to be most susceptible, and canker is seldom found on those which are yellowish, unhealthy, very young, or very old. Citrus canker first appears on the leaves as a pimple-like spot which by reflected light has a yellowish-brown, translucent, glazed, oily appearance. By direct light the color is yellow. It may first become visible on either surface, but sooner or later makes its way to the opposite side. When it develops very rapidly, evidences of infection may be observed on both surfaces almost simultaneously. Very young canker infections on the leaves are represented on Plate I, figure 5; Plate X, figure 3; and Plate XII, figure 1. Sooner or later the tissue ruptures in the center of the infected area, giving to the ruptured portion a whitish or pinkish, wartlike, corky appearance. This rupturing may occur on either surface first, or it may occur on both surfaces simultaneously. The ruptured portion is covered by a grayish membrane. The yellowish-brown, glazed, oily, translucent appearance is always present in the outer unruptured zone where the canker organisms are most active, unless this zone is invaded by other organisms. Sometimes the ruptured portion is very large in proportion to the glazed, oily, translucent zone, so that the latter is scarcely visible without the aid of a hand lens. Such spots have a whitish appearance, and are likely to project more prominently than spots where the ruptured portion is proportionately smaller. (Plate XII, figure 1.) The yellowish-brown, glazed, oily, translucent zone is usually surrounded by a yellowish-green zone which shades more or less abruptly into the normal green of the leaf. (Plates I, II, III and IX.) This zone varies greatly in size, and may be almost, if not entirely, lacking. (Plate X, figure 3; Plate XII, figure 1.) As the disease advances the infected area increases in size, and in typical cases

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the lacerated membrane breaks open in the center, leaving a hole, which gives to the spot a crater-like appearance. (Plate I, figures 1 and 2; Plate II, figures 3 and 4; Plate III, figures 3 and 4.) The spots usually mature when they reach a diameter of a quarter to half an inch. They are typically circular in outline, more or less elevated on both surfaces, and may occur singly or in groups. When in groups they often fuse, forming larger more or less irregular areas. The central portion of the diseased area may drop out, leaving a hole through the leaf. The corky portion is frequently invaded by other organisms which sometimes greatly modify its appearance, often causing it to turn pink or various shades of brown to black. These organisms may grow out into the oily, glazed, translucent zone and modify its appearance, causing it to become cloudy or of a different color than that which is typical of the disease. Spots very similar or almost identical to these may result from other leaf troubles, and it is sometimes almost impossible to tell whether or not there are canker organisms in spots which are not typical, without making cultures from them. In several instances the writer has obtained cultures of the canker organism (*Pseudomonas citri* Hasse) from spots which had been so modified in appearance by other organisms as to be scarcely recognizable as canker, and has produced typical canker infections on apparently healthy trees with these organisms. Any part of the leaf may become infected, and canker is frequently found on the midrib (Plate I, figures 1 and 2; Plate II, figures 3 and 4), along scratches made by thorns (Plate I, figures 3 and 4; Plate X, figure 3) and on the edge of bites made by grasshoppers or other insects (Plate III, figures 1 and 2). When the petiole is infected or when there are canker spots on the leaf, defoliation may occur.

ON THE TWIGS, THORNS AND BRANCHES.

The young tender twigs and thorns are more subject to citrus canker than are the older, more corky ones. The disease first manifests itself on the young twigs as a small, pimple-like, watery, yellowish-brown spot which increases in size as the disease advances. Sooner or later the diseased tissue ruptures, causing it to become corky and of a lighter color. Further rupturing of the tissue may cause the formation of fissures and cracks. The corky portion is more or less covered with a lacerated, grayish membrane and is surrounded by an oily, glazed, transluscent, yellowish-brown zone very similar to that on the

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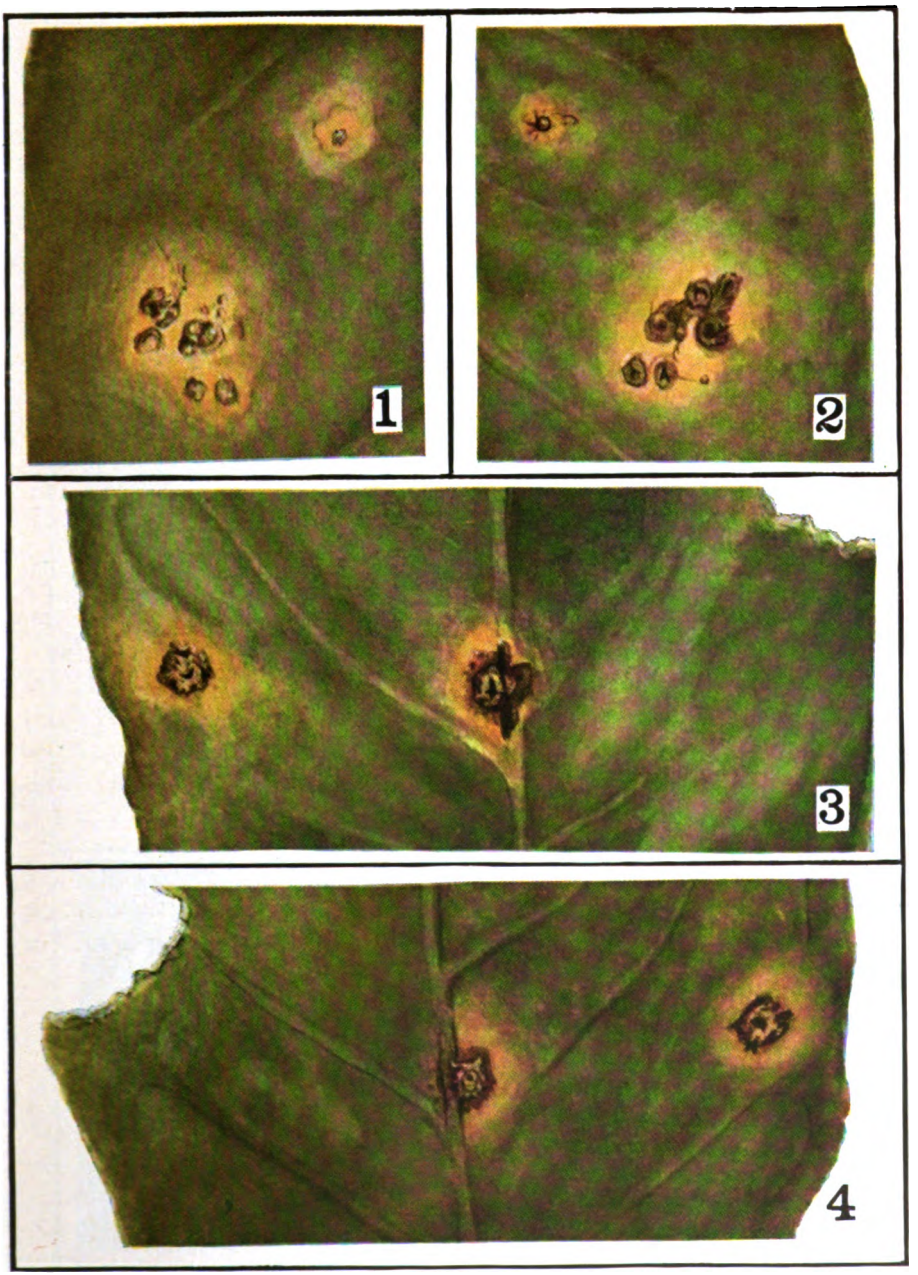

Figure 1. Young canker on lower surface of grapefruit leaf. Enlarged three diameters. Collected in South Dade County. Figure 2. Upper surface. Figure 3. Mature canker on upper surface of grapefruit leaf. Enlarged three diameters. Collected in South Dade County. Figure 4. Lower surface.

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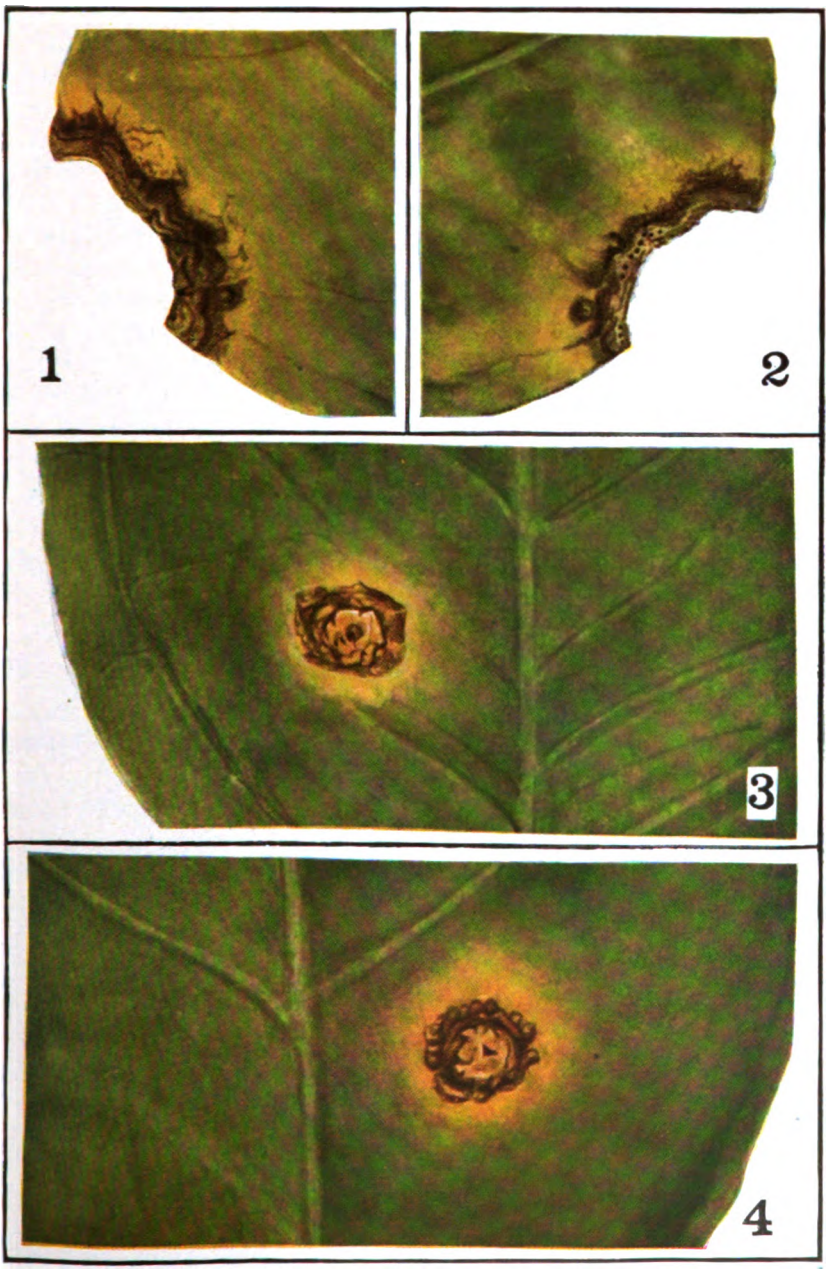

Figure 1. Canker on lower surface of grapefruit leaf along insect bite. Enlarged three diameters. Collected in South Dade County. Figure 2. Upper surface. The black dots are fruiting bodies of a fungus which has attacked the cankered tissue. Figure 3. Mature canker on lower surface of grapefruit leaf. Enlarged three diameters. Collected in South Dade County. Figure 4. Upper surface.

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leaf, which shades rather abruptly to the normal green of the twig. (Plate IV; Plate IX, figure 1; Plate XII, figure 1.) The spots mature when they reach a diameter of three-eighths to one-fourth of an inch, and are typically circular and raised with somewhat irregular edges. The corky portion frequently becomes very dark in color, due to the presence of other organisms. Canker infections may occur singly, or they may occur in groups and fuse, causing more or less irregular areas. Sometimes they are so numerous that the twig is girdled. Canker appears the same on thorns as it does on the twigs. On the larger limbs it appears much as it does on the twigs, except that it is somewhat rougher, more prominent, and more or less irregular in shape with complete disappearance of the surface membrane in older spots (Plate X, figures 1 and 4). Canker may mature on the older wood while the spots are still very small, and such canker is often very difficult to find, especially when hidden by fissures and cracks in the bark.

ON THE FRUIT.

As the fruit matures it seems to become less and less susceptible to citrus canker, and mature picked fruit seems to be immune. Ripe picked citrus fruits have been repeatedly inoculated by the writer with canker organisms (*Pseudomonas citri* Hasse), and no canker was ever found on them, altho they were kept in moist chambers in a saturated atmosphere until they were rotted by other organisms. Organisms from the same cultures produced abundant infection of the leaves and twigs of growing citrus plants. Very few small and no immature canker spots have been observed by the writer on mature fruit, while young, immature infections are very numerous on green cankered fruit. As an illustration of this, figure 2 on Plate V may be compared with figure 2 on Plate VI. Very young infections on the fruit appear very similar to those on the twigs and leaves. After the tissue is ruptured the spots become very corky, and large fissures and cracks often appear. (Plate V; Plate VI; Plate VII; Plate VIII; Plate X, figure 2; Plate XII, figures 2 and 3.) The spots may occur singly but are more likely to occur in large number and fuse, causing large diseased areas. Where they are very numerous, gumming may result. (Plate VI, figure 1.) Badly infected fruits may ripen prematurely and fall, but even if they do remain on the trees and mature, they are unsightly and unsalable. The disease itself does not penetrate very deeply into the rind (Plate VI, figure 3), but the cracking and breaking of the skin make

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conditions favorable for the entrance of other organisms which rot and decay the fruit.

Appearance on Different Hosts.

Although the symptoms of citrus canker are quite characteristic there are some variations in its appearance on the same host as well as on different hosts. It appears very similar on the leaves of grapefruit, tangelo, sour orange and lemon. On the leaves of the Key lime the color is sometimes darker than on the grapefruit. On orange leaves infections are sometimes slower in becoming visible on both surfaces, and the spots may be much darker in the center than on grapefruit. On the fruit of the orange the spots are likely to be roughened throughout instead of having distinct cracks and fissures as in the case of the grapefruit and tangerine. Canker on the leaves of tangerine and king orange seems to be darker in color than on grapefruit, and the oily, translucent zone has a bluish tinge. Canker on tangerine fruit has deeper and more distinct fissures than on grapefruit, and cracks frequently extend across the entire surface of the spot (Plate XII, figures 2 and 3). The disease has not been observed on fresh tangerine fruit or on satsumas by the writer. Mr. A. L. Swanson states that on tangerine fruit the spots are larger than on grapefruit and considerably darker, especially in the very center of the spot, that this shades off to a gray-green near the edge, and to a distinct green at the very edge. Wolf (1916) describes it on satsumas as follows: "In the case of canker on satsumas, however, there is little or no elevation of the upper surface. Neither is the oily margin so evident on this host, especially in case of old cankers, in which the diseased tissues have become dark brown, simulating the appearance of melanose." The only canker observed by the writer on kumquat was that produced on the leaves and twigs by inoculation with the canker organism. In this case the color was considerably darker than canker on grapefruit. The disease developed very slowly in comparison with other citrus varieties and was very slow in becoming visible on both surfaces of the leaf.

Appearance at Different Seasons.

Weather conditions and the condition of the host have some effect upon the appearance of citrus canker. The disease does not develop as rapidly in cool, dry weather as it does in warm, damp weather and this probably explains why it appears somewhat different in winter than it does in summer. The main dif-

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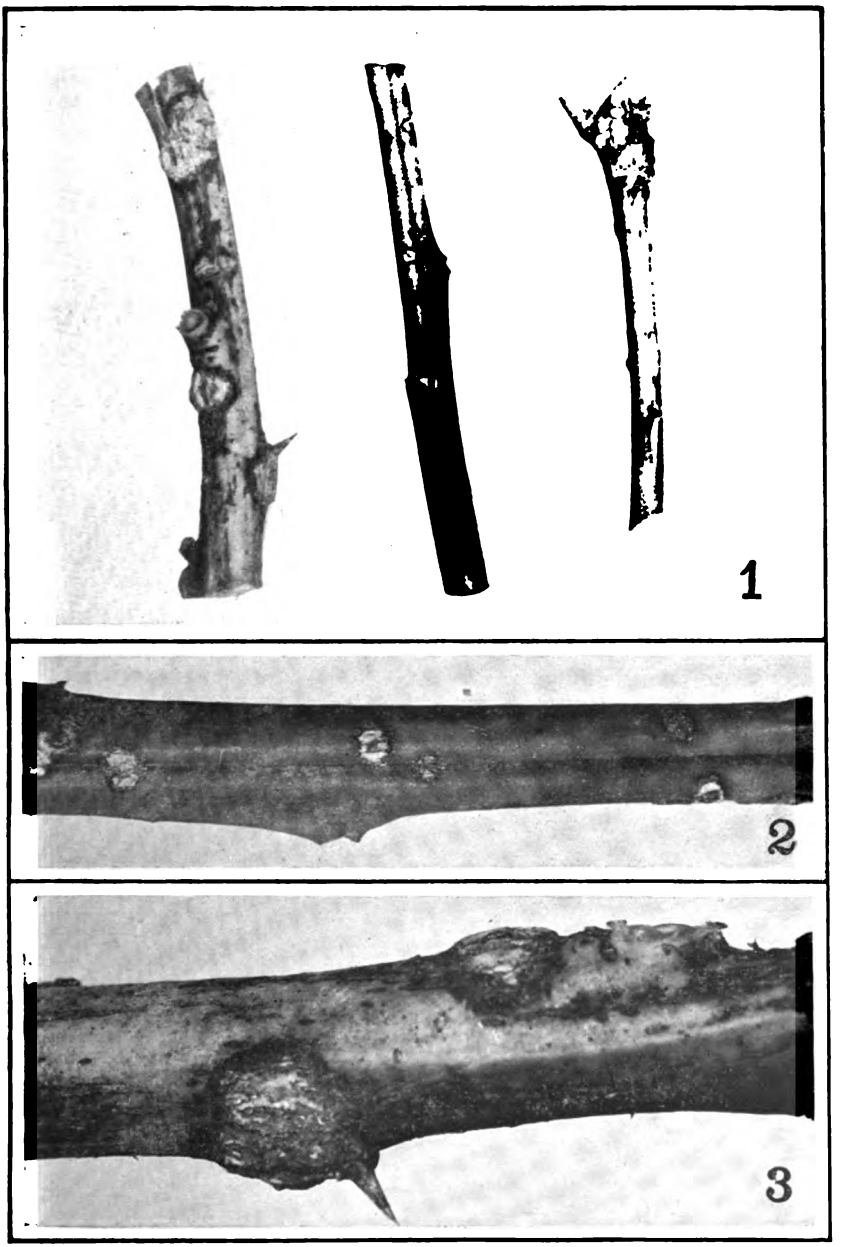

Figure 1. Canker on grapefruit twigs. Natural size. Figure 2. Young canker on grapefruit twig. Enlarged three diameters. Collected in South Dade County. Figure 3. Mature canker on grapefruit twig. Enlarged three diameters.

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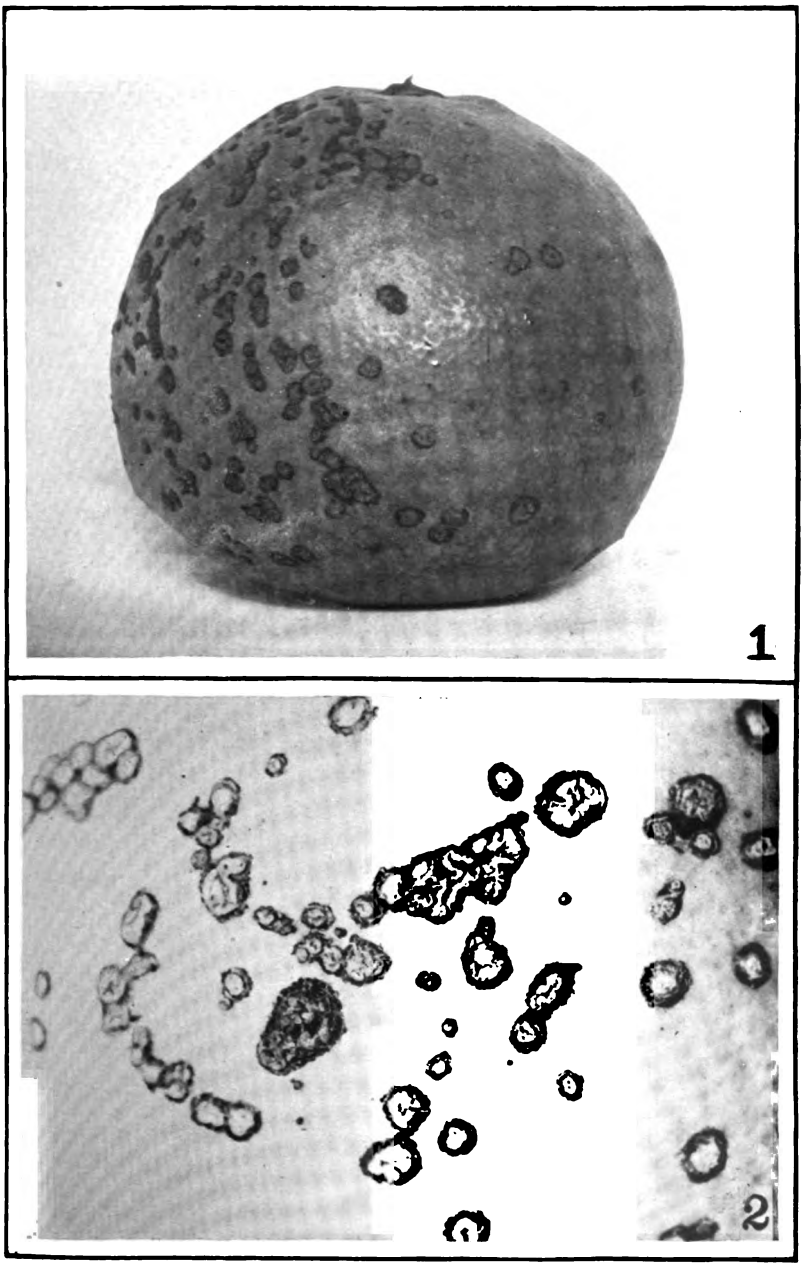

Figure 1. Canker on green grapefruit. Natural size. Collected in South Dade County. Figure 2. A portion of the surface of the grapefruit represented in Figure 1 enlarged three diameters. Note the proportionately large number of immature infections as compared with ripe grapefruit (Plate VI, Figure 2).

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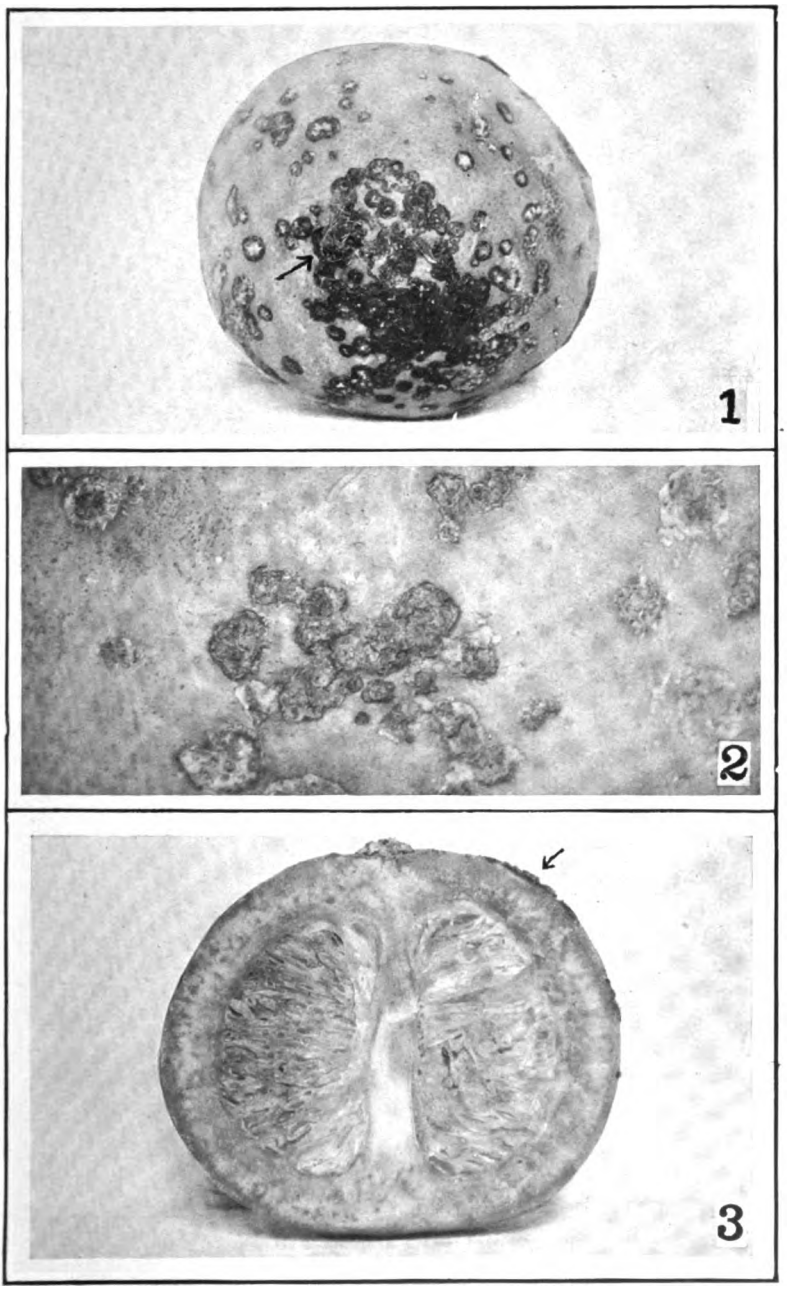

Figure 1. Green grapefruit badly infected with canker. Natural size. The arrow points to a mass of gum which has exuded from the fruit as a result of the disease. Collected in South Dade County. Figure 2. Portion of the grapefruit represented in Plate VII enlarged three diameters. Note the corky appearance of the infected portion and the comparatively few young infections. Figure 3. Cross-section of a green grapefruit infected with citrus canker. Note that the disease does not penetrate very deeply into the rind, also the raised character of the diseased portion. Natural size.

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ference in the appearance of the disease during these seasons is that in winter the spots are likely to be darker in color and the yellowish-green halo is likely to be less prominent or wanting. On hard, yellow leaves canker is always likely to have this appearance.

Comparison of Citrus Canker with Other Citrus Diseases.

Scab. Citrus canker and scab are very similar in appearance during their earlier stages, in fact when canker was first brought to the attention of Berger (Tenny, 1914), it was thought to be an unusual manifestation of citrus scab. In the earlier stages both scab and canker spots may be circular, raised on both surfaces, and have a corky appearance in the center. They may be distinguished by the fact that in canker the outer zone has a watery, oily, translucent, glazed appearance which is lacking in scab. As the diseases advance, the differences between them become more and more marked, and scab distorts the leaves and produces marked wartlike projections on the fruit, whereas these characteristics are wanting in canker.

Scaly Bark. Both scaly bark and canker cause raised, more or less circular lesions, and both cause brown discoloration of the diseased portion, which may be bounded by a yellowish-green zone. They may be distinguished by the fact that in canker there is always a watery, oily, glazed, translucent zone, and the center of the infected area sooner or later becomes more or less spongy, while in scaly bark the spots are hard and glazed throughout.

Melanose. Melanose and canker are similar in that they both produce raised spots which during certain stages of their development may be similar in color. They can be distinguished by the fact that the watery, oily, glazed, translucent zone is wanting in melanose, and that in the latter disease the spots are glazed throughout without any central spongy portion. In melanose the color is usually darker and the diseased spots do not, as a rule, penetrate to both surfaces of the leaf. However, when both surfaces are affected, a much smaller affected area is visible on the lower surface, in the case of any one spot. There is usually no yellowish-green halo around the spot in melanose.

Greasy Leaf. This disease resembles canker in causing a spot which is frequently convex on both surfaces of the leaf, may be similar in color, and be broken open in the center. It may be distinguished from canker by the fact that there is no watery,

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oily, glazed, translucent zone, there is usually no yellowish-green halo. The infected area is usually less regular in outline, and the center of the spot does not have a corky appearance. Greasy leaf does not occur on the fruit or twigs.

ANTHRACNOSE OR WITHERTIP. This disease resembles canker in that both may produce a yellowish-brown spot surrounded by a yellowish-green halo. They may be distinguished by the fact that the watery, oily, glazed, translucent zone is not present in anthracnose, the spots do not have a spongy character, but are hard and glazed, and that anthracnose spots are sunken while canker spots are raised.

FROST, MECHANICAL AND OTHER INJURIES. Spots which resemble canker are frequently produced on nursery stock by frost or mechanical injuries. They may be circular, have a corky appearance where the tissues have been killed, be brown in color, and may even be somewhat raised. They can usually be distinguished from canker by the absence of the glazed, oily, translucent zone, and by the fact that they are not likely to be as much raised as are canker spots.

Many leaf troubles besides those mentioned may produce spots which resemble canker, but they can usually be distinguished from it by the absence of the oily, glazed, translucent zone. However, in canker spots this zone is sometimes so modified in appearance by the presence of other organisms that it can scarcely be recognized. The presence of the canker organism in such spots can only be determined by waiting for it to develop in a typical form elsewhere on the tree, or by cultural methods.

IMPORTANT POINTS

Citrus canker is spread from tree to tree by any agency which can serve as a carrier for the canker bacteria. Among the agencies responsible for spread of the disease from one tree to another in the same property and from one grove to another in the same locality may be mentioned insects, birds, domestic animals and human beings. Man himself has thus far been the most active agency in this respect. Spread of the disease has been repeatedly, and in the majority of cases, traced to the movement of laborers, fruit-pickers or other workmen from one grove to another.

Dissemination from one locality to another has invariably been by the shipment of nursery stock which was either infected or which had been exposed to infection. As no case of dissemi-

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Ripe grapefruit infected with citrus canker. Natural size. Collected in South Dade County.

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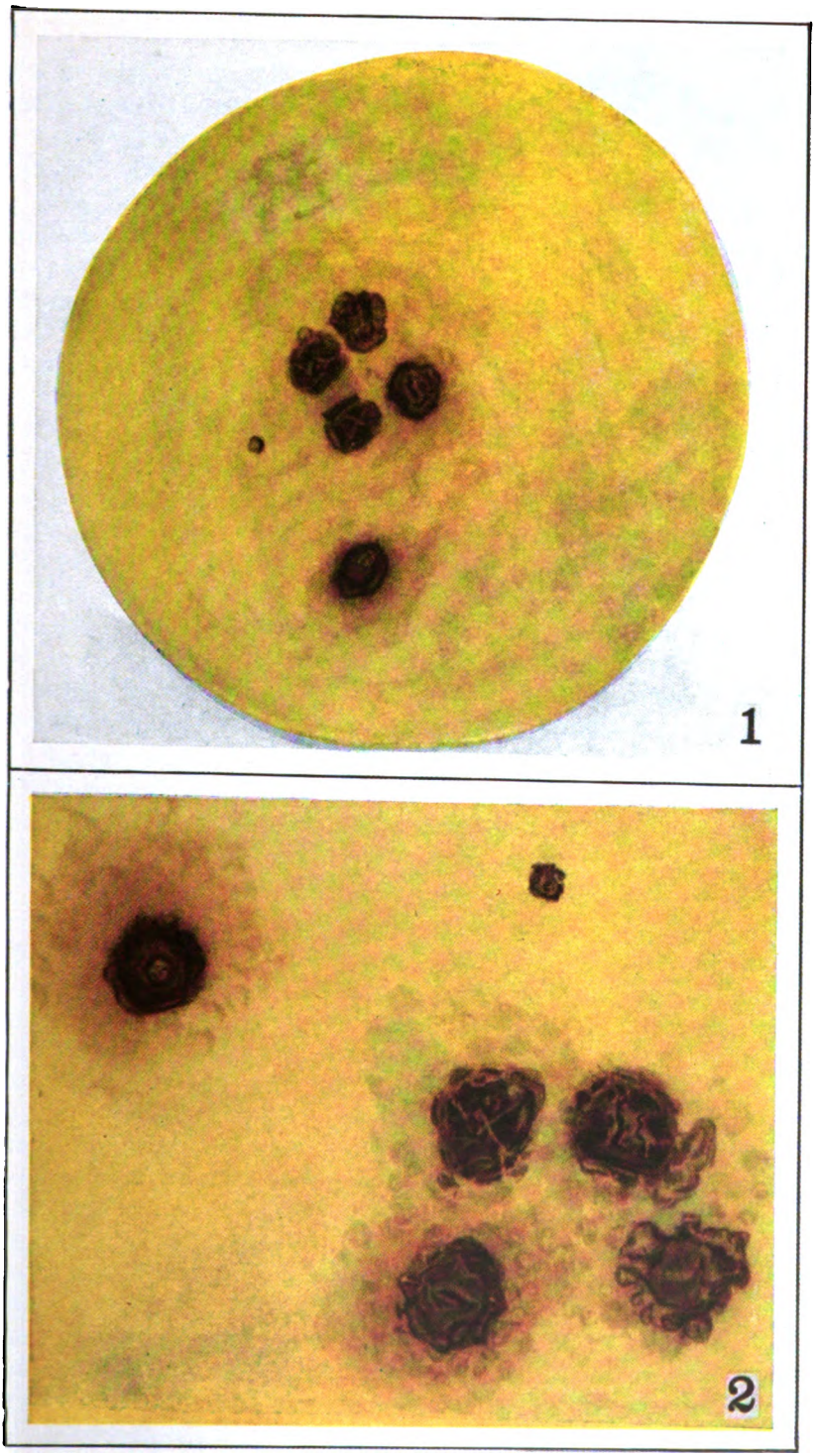

Figure 1. *Mature canker on grapefruit. Natural size. Collected in South Dade County.* *Figure* 2. *Portion of the fruit represented in Figure* 1 *enlarged three diam-*

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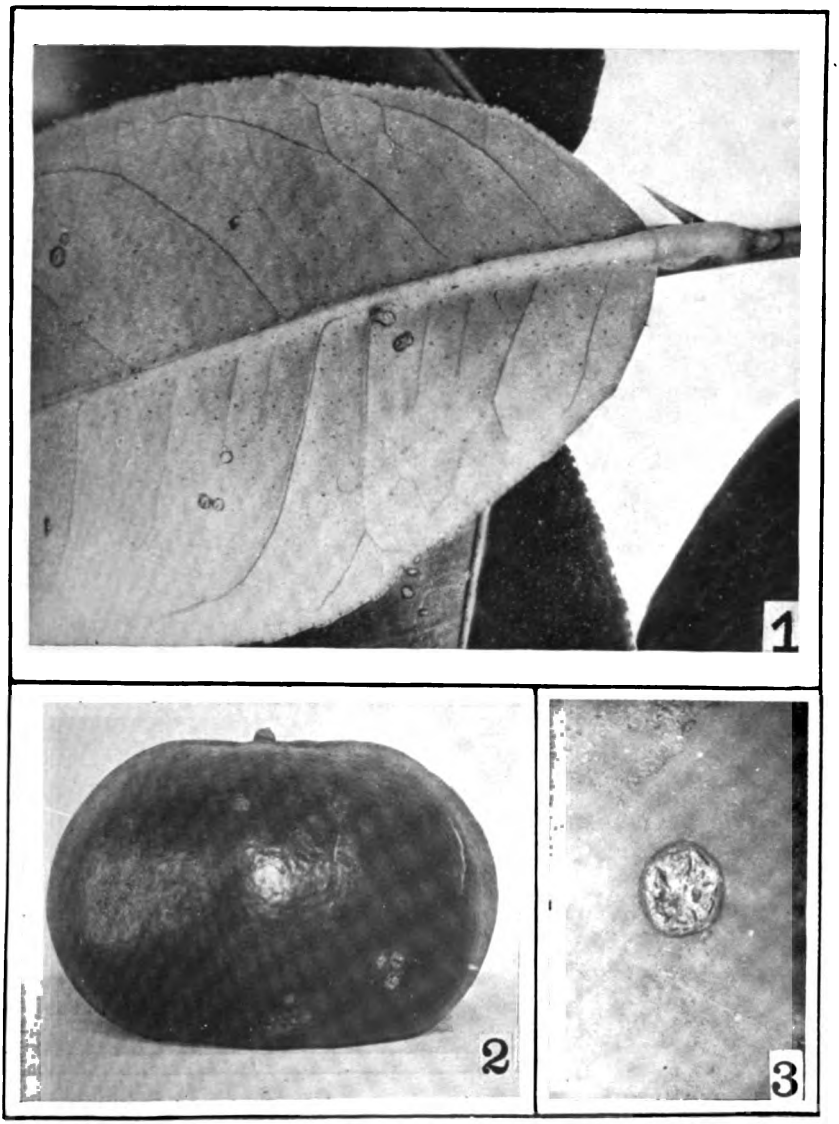

Figure 1. Canker on leaves and twig of ponderosa lemon produced by inoculation with canker organisms (Pseudomonas citri Hasse). Enlarged three diameters. Canker was first observed twenty-two days after inoculation and was photographed five days later. Figure 2. Canker on fruit of tangerine. Natural size. Collected in Brevard County. Figure 3. Canker on tangerine fruit enlarged three diameters. Note the deep cracks and fissures. These are characteristic of the disease on tangerine fruit. Collected in Brevard County.

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JANUARY, 1917

Vol. I

THE QUARTERLY BULL

OF THE

STATE PLANT BO

OF FLORIDA

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Plate XIII.—The Tropical Laboratory. Erected at Redland, Dade County, by the South Dade County Fruit Growers' & Truckers' Association. The building contains a spacious auditorium used for Association meetings and a commodious laboratory room used by the State Plant Board for citrus canker investigations (Original).

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. 1 JANUARY, 1917 No. 2

DIRECTIONS FOR BUILDING FUMIGATING BOXES AND FOR FUMIGATING WITH HYDROCYANIC-ACID GAS

E. W. BERGER

The following directions and illustrations represent a type of fumigating box long in use in Florida, and are largely based on directions found in Bulletins 67 and 76, Florida Experiment Station, by H. A. Gossard. It can be constructed of any kind of material; wood, concrete, brick, etc. The materials used for the box indicated in the directions are wood, galvanized iron, felt roofing, and concrete for the foundation. The galvanized iron top, or lid, soldered along the riveted joints, is recommended, because it is absolutely gas-tight and also rain-proof. The iron lid, or cover, is supported by three 2″x3″ strips of wood, lengthwise underneath, and three 2″x4″ strips, crosswise on top, all bolted together through the cover. The three strips of wood on top serve to hinge the cover to the three posts back of the box, and the middle strip also serves for attaching the rope. The body of the box is built of plain boards, placed horizontally, double walled, with a 4-inch space between the walls all around, which space is filled with dry sand to make it air-tight. The boards should be nailed every three feet to upright pieces, or studs, 2 by 4 inches, placed within the double walls. All the upright pieces within the double walls must be 2 inches shorter than the height of the box to allow space for the flange on the cover. The outside walls of the box are covered with a good quality of felt roofing to keep them dry.

A concrete foundation, 6 by 8 inches, or as much deeper as necessary, is recommended, as it will keep the box off the ground and from rotting, especially if the covering of felt roofing on the sides is allowed to project ½ inch below the box proper and over the foundation. The space inside the foundation is filled with dry earth, and no other kind of floor is needed. Plants with roots likely to be injured by fumigation may be "heeled in" in the earthen floor and then fumigated.

If cheapness is a desideratum, or if the box can be built

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under cover of a building, the covering of felt roofing and the concrete foundation can be omitted, and the lid made of boards, lined with felt paper, with flange of tin or wood.

If desired, a small door about 1 foot square, for inserting the chemicals when fumigating, may be constructed at the middle and base of the front side. This must be made to fit tightly by means of felt and kept closed and in place by some suitable device. The writer has himself preferred to introduce the chemicals through the top, suspending the cyanid over the fumigating jar by a string passing through a piece of gas pipe

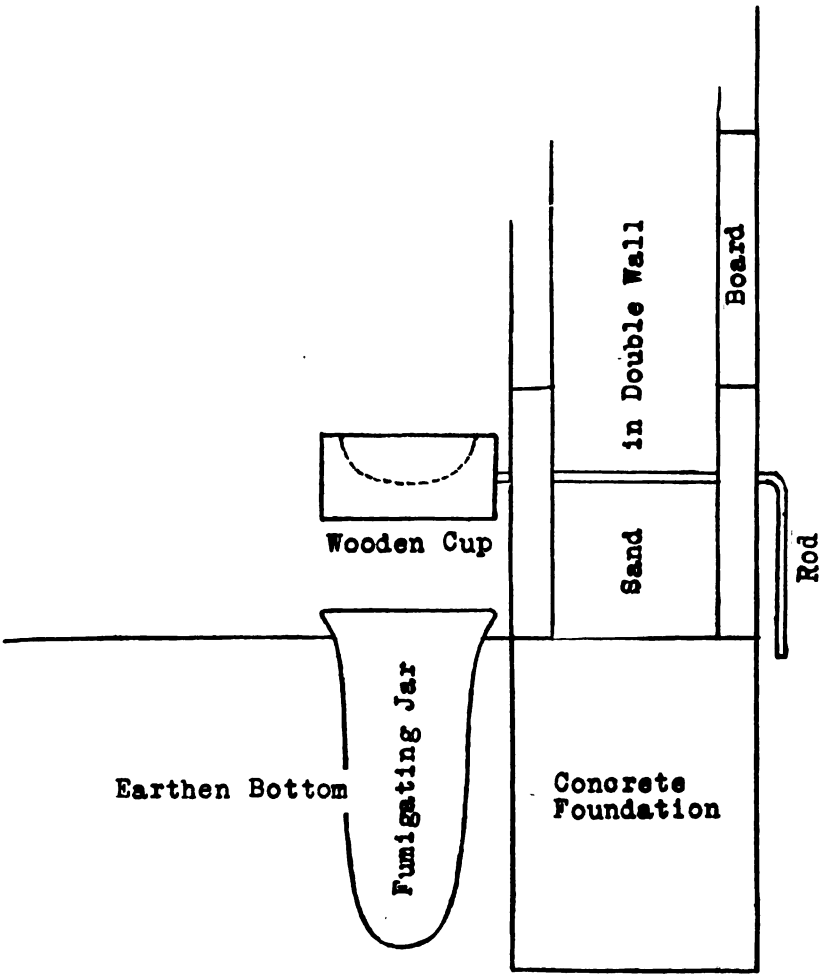

Fig. 1.—Cross section through front wall of fumigating box between xx (figs. 2 and 3), illustrating the rod-and-cup device for dropping the cyanid (About ¼ actual size).

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near "x" (See Plates XIV and XV). After placing the trees and closing the box, the cyanid is released and the gas pipe closed with a stopper.

Another, less simple but more practical, device for dropping the cyanid into the fumigating jar containing the water and acid has been suggested by a correspondent. This consists of an iron rod, 3/16 or ¼ inch in diameter, inserted through the front wall between "xx" (See illustrations). The rod must project 2 or 3 inches on the inside of the box, far enough to extend over the fumigating jar, and on the outside far enough so that it can be bent once at a right angle to form a crank 3 to 6 inches long, but without a handle. When in position on the box, the crank of the rod should be turned down, and a wooden block, about 4 inches square and 2 inches thick, fastened to the inner end of the rod by inserting the latter into a suitable hole bored into one edge of the block. The upper surface of the block should be hollowed out sufficiently like a shallow cup to hold about an ounce of cyanid. This rod-and-cup device should be sufficiently below the rack (See next paragraph) for supporting the trees so that when the block, or cup, is inverted by turning the crank on the outside it will drop the cyanid into the vessel beneath it without touching the rack. With the rod-and-cup device, the cyanid need not be wrapped in paper.

Some form of simple rack, or false bottom, for keeping the trees to be fumigated off the earthen bottom, or floor, should be constructed. This can be done by nailing two cleats, about 6 inches from the bottom, on the sides for supporting suitable cross-pieces. The gas is generated beneath this rack so that it will readily spread throughout the space under the rack and then diffuse upward through the trees. A few short pieces of boards, together about a foot square, should be arranged each time, before placing the trees to be fumigated, immediately above the vessel in which the gas is generated, in order to spread the gas and to keep it from injuring the trees immediately above. If a string is provided to release the cyanid, this should pass through a crack between these boards.

A fumigating box recently constructed for the Plant Board and University of Florida, herewith illustrated, was built of these materials, and it is believed will last 25 years without repairs, except that the posts to which the lid is hinged and the tackle fastened, and the wood on top of the lid, may have to be replaced in time. After some years the galvanized iron

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top may require a coat of paint. This box cost, completed, about $40.00.

If the extent of the business requires larger fumigating accommodations, an air-tight house of necessary size may be built, having at least two chambers so that one can be emptied and refilled while the other is being fumigated. The fumigating chambers in such a house are perhaps best made air-tight by plastering them with an extra heavy coat of ordinary house plaster. The doors should be made of two thicknesses of matched flooring, well painted, and with tarred paper between. They can be made to fit air-tight by means of strips of felt against which the door is clamped by means of some convenient device. Large ventilators that can be opened from the outside should be constructed near the ceiling for ventilating the rooms after fumigating.

Summary of Dimensions

The following specifications are for a box of 99 cu. ft. capacity, or practically 100 cu. ft., a very convenient size. Double walls of plain boards, covered on outside with felt roofing. Inside measurements, 3 ft. wide, 11 ft. long, 3 ft. high; outside measurements, 4 ft. wide, 12 ft. long, 3 ft. high. Uprights between walls, at corners and sides, to which the boards are nailed, 2 by 4 inches, by 2 ft. 10 in. high.

Galvanized iron cover, or lid, 4 ft. 8 in., by 12 ft. 8 in., allowing 4 inches extension at edges like a roof. Galvanized iron flange, as per illustration, projects 2 inches downward from under side of cover. Space inside flange is 3 ft. 6 in. by 11 ft. 6 in. Downward projecting part of flange is 7 inches from outer edge of cover. It is believed that, if ½ inch of the outer edge of lid were turned down like a small flange or beaded and stiffened with a heavy wire, the same would look better and keep the edge of the cover from warping.

Concrete foundation, 6 in. by 8 in. Space inside, 3 ft. by 11 ft.; outside measurements, 4 ft. by 12 ft.

Posts, 6 in. by 8 in., placed about 6 inches from back of box, may be used for hinging cover and attaching rope and pulley. In the illustration, four posts were used, but three are sufficient, the middle one being allowed to extend at least 6 ft. above top of the box. These posts should extend 3 to 4 feet into the ground.

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Supplies Needed

Cyanid, sulphuric acid and water are the materials employed. Potassium cyanid was, until a few years ago, used, but sodium cyanid has now come into general use. Sodium cyanid is cheaper and is an American product; besides, the potassium cyanid cannot be readily obtained at this time.

The cyanid used, if sodium cyanid, should be 96-98% pure; if potassium cyanid, it should be 95-96% pure. Sodium cyanid has sometimes been designated as 129% cyanid, since an equal amount by weight of sodium cyanid liberates 29% more gas than does potassium cyanid. It is now designated as 96-98% cyanid.

It must never be forgotten that cyanid is a DEADLY POISON and that a very small amount if introduced into the mouth will cause death. It is best to use forceps in handling it, and never allow it to touch cuts or open sores on the hands. It should be kept away from children and uninformed persons. The gas generated from it is very deadly and while no fatalities have ever attended its use as an insecticide, such have occurred in chemical laboratories, and the greatest caution should be observed in working with it. It should be kept in tightly stoppered glass bottles or tightly closed fruit jars, since it will deteriorate rapidly and absorb moisture if exposed to the air.

Cyanid can be obtained in one ounce egg-shaped pieces or in the granular form. Unfortunately, an ounce piece is too large for the 100 (99) cu. ft. box recommended, and only a few persons will probably have use for a larger box. Those desiring to do so may build a box of 200 cu. ft. capacity, when a one-ounce piece will just be sufficient to fumigate citrus trees. To avoid the inconvenience of breaking the one ounce pieces, the majority no doubt will prefer to use the granular kind.

The following prices on granular sodium cyanid were received on June 28, 1916, f. o. b., New York:

1 tin 50 pounds at	29½c	per lb.
1 tin 25 pounds at	31 c	per lb.
1 tin 10 pounds at	31½c	per lb.
1 tin 5 pounds at	32 c	per lb.
1 tin 1 pound at	35 c	per lb.

Cyanid can be obtained from druggists, wholesale druggists, and manufacturers of chemicals.

Commercial sulphuric acid, 66 degrees Baume, which is approximately 93% pure, must be employed. This can gen-

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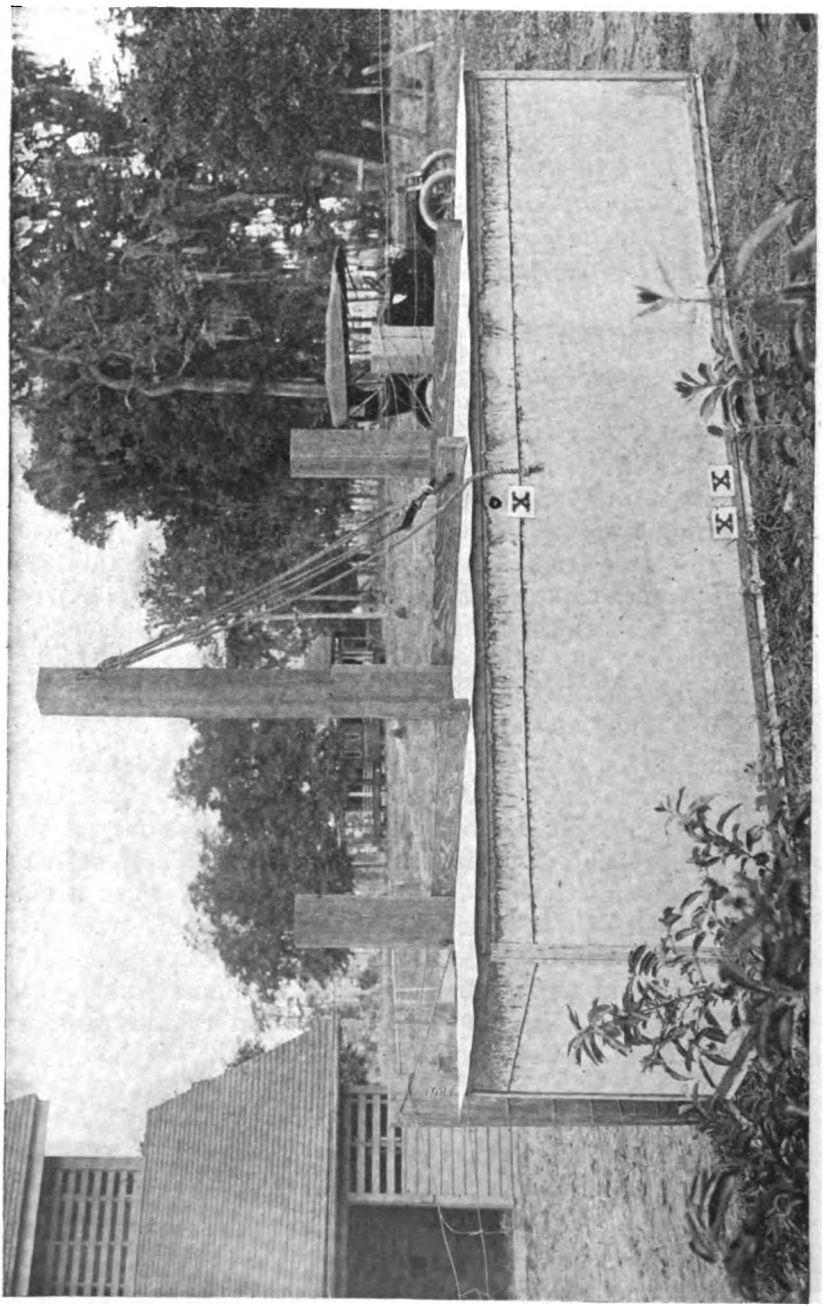

Plate XIV.—Fumigating box (Original).

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erally be obtained from druggists, wholesale druggists, or fertilizer manufacturers.

Vessels of earthenware, china or glass must be used for generating the gas, since the acid employed will rapidly destroy metal and wood. An ordinary pint fruit jar will do for ½ oz. to 1 oz. of cyanid, but a narrower vessel with a bowl-shaped bottom is better, in order that the liquid (acid and water) will be deeper and better cover the cyanid when put in. A deep pint glass tumbler, a deep earthenware bowl, or a large coffee cup would also be excellent. A vessel holding only ½ pint is rather small for the amount of cyanid and chemicals necessary to charge a 100 cu. ft. box like previously described, since the liquid may boil over.

For measuring liquids, a glass graduate, or measuring glass, having a capacity of three or four liquid ounces, graduated in fourths or eighths of an ounce, is required. A glass graduate, graduated in the metric system, may be used, and 30 cubic centimeters allowed for an ounce. Druggists should be able to supply these graduates. Suitable scales for weighing ounces and fractions of an ounce are necessary.

FORMULAS

SODIUM CYANID.—To fumigate citrus trees, immature peach trees, roses, buds and scions in a fumigating box, with sodium cyanid, ½ oz. per 100 cu. ft. space is required. The necessary amounts (liquid measure) of acid and water are respectively 1½ and 3 times the amount of sodium cyanid as expressed in avoirdupois ounces.

To fumigate dormant peach trees, or similar hardy deciduous trees like apple, pear and plum, with sodium cyanid, ¾ oz. per 100 cu. ft. box space is required.

The formulas for fumigating with sodium cyanid may be tabulated as follows:

Citrus, etc.:

½ oz. sodium cyanid, 96-98% pure.
¾ oz. sulphuric acid, 66 deg. Baume, or 93% pure.
1½ oz. water.
Time 30 minutes.

Peach, etc.:

¾ oz. sodium cyanid, 96-98% pure.
1⅛ oz. sulphuric acid, 66 deg. Baume, 93% pure.
2¼ oz. water.
Time 30 minutes.

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POTASSIUM CYANID.—The formulas for potassium cyanid are included for the benefit of those who may still have this cyanid on hand.

Citrus, etc.:

3/5 oz.* potassium cyanid, 95-96% pure.
3/5 oz. sulphuric acid.
1-4/5 oz. water.
Time 30 minutes.

Peach, etc.:

1 oz. potassium cyanid.
1 oz. sulphuric acid.
3 oz. water.
Time 30 minutes.

CHARGING THE BOX

Place the vessel for generating the gas, containing the necessary amount of water, in position on the earthen floor, inside the box near the middle of the front wall. This vessel may be partly buried in the earth of the floor to support it in position. After the water, add the required amount of acid. Adding the acid will heat the mixture. (*Always* pour the acid into the water, *never* the water into the acid, in order to avoid splattering of the liquids). Next suspend the required amount of cyanid, wrapped in a bit of tissue paper, in the mouth of the generating vessel (but not touching the liquid for the poisonous gas is immediately generated) by means of a string passing through the front wall at x (See illustration); or place it in the cup of the rod-and-cup device described on page 16.

After placing the chemicals in readiness, place the trees to be fumigated into the box and close down the lid. See to it that the space between the walls is full of sand so that the flange on the lid will make a tight joint. Release the string, allowing the cyanid to drop into the mixture of acid and water, stopper the opening for the string and wait 30 minutes; or if the rod-and-cup device is used, simply turn the crank. Fumi-

*Since 2/3 or 3/4 ounce may be more conveniently weighed on most scales than 3/5 ounce, these quantities may be employed; but as the dosage is thereby slightly increased, it is advised that experimental trials of these dosages be made before regularly employing them. The proportions of potassium cyanid, acid and water are 1: 1: 3, respectively, i. e., the number of ounces of acid (liquid measure) is the same as the number of ounces of potassium cyanid (ounces avoirdupois), and the number of ounces of water (liquid measure) is three times the number of ounces of potassium cyanid (ounces avoirdupois).

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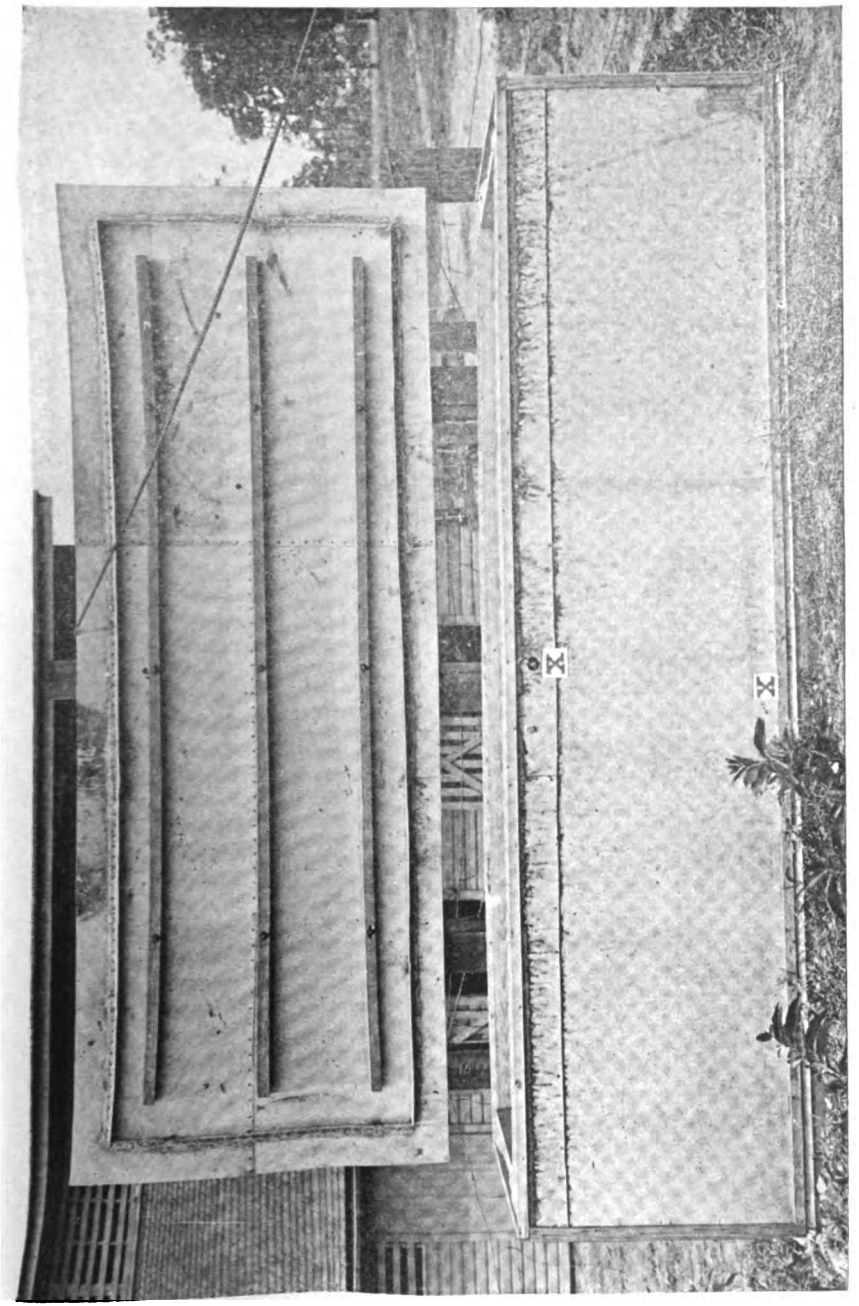

Plate XV.—Same box as Plate XIV, but with cover raised (Original).

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gate while the mixture of acid and water in the generating vessel is still warm.

If the box has a small door on the side for introducing the chemicals, the trees should be placed in the box first and the lid closed down. The chemicals are then introduced through the small door: the water first, then the acid, and lastly the cyanid wrapped in a bit of tissue paper. As soon as the cyanid has been dropped into the generating jar, or vessel, rapidly close the door and fasten it into position.

After 30 minutes open the lid and allow the box and contents to air for some minutes, before removing the trees. The residue in the generating vessel should be buried as it is corrosive and poisonous.

Miscellaneous Suggestions

Trees and plants to be fumigated should have no visible moisture upon them; neither should they be packed so closely that the gas cannot circulate between them.

All citrus and deciduous trees should be defoliated as required by law before fumigation, as the leaves are quite certain to be injured by the gas and will interfere with the fumigation. Ornamental citrus in tubs or pots, and ornamentals in general, not intended for sale or exchange, may be fumigated without defoliation by employing a smaller dosage, which dosage may have to be determined by trial.

Those desiring more detailed information on the fumigation of many plants are referred to "Fumigation Methods," by W. G. Johnson, the Orange Judd Company, New York.

CHARACTERISTICS OF CITRUS CANKER AND OF THE CAUSAL ORGANISM

R. A. Jehle

A previous article* by the writer was devoted to descriptions of citrus canker and to the means of identifying it. The present paper aims to give such additional information as will enable citrus growers to attain an adequate knowledge of the disease, its nature and the respects in which it differs radically from other diseases.

*The Quarterly Bulletin, Vol. I, No. 1, pp. 2-12 (1916).

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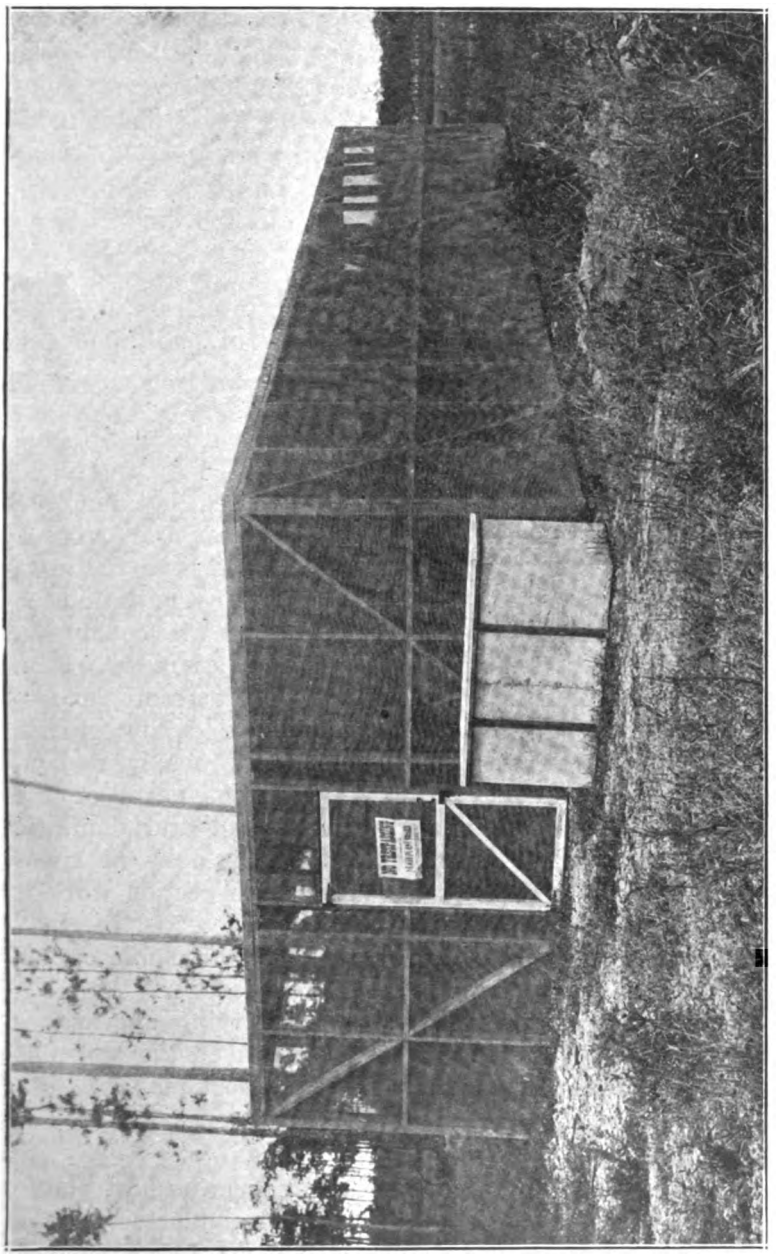

Plate XVI.—Screened cage, with compartments, used for experiments with citrus canker. In the foreground is a galvanized box used for fumigation experiments (Original).

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Field Investigations

The writer commenced his investigations of citrus canker in Dade County in August of 1915. The disease was carefully studied in the field but the opportunity for such observation was considerably limited as the infected trees are destroyed as soon as possible after being discovered.

One of the first characteristics noted was that, where several infections occurred on a single tree the younger ones were usually located below the older ones, frequently very near to them. Sometimes one mature infection was observed with numerous immature infections below radiating from it. Infections were often observed along the edges of bites made by insects (Plate XX, 1), and on other parts of the leaf adjacent to them.

Sometimes most of the trees which were found to be infected in a grove were located along paths frequented by men and domestic animals. In other groves, frequented by domestic fowls, most of the infections were located near the ground. There are cases on record where infections have been found in the tops of trees, apparently on account of dissemination by insects or birds. These observations lead to the conclusion that the disease is distributed by mechanical carriers. Rain and dew play an important part in carrying it from place to place upon the same tree or to adjoining trees during storms or when the branches interlock. Insects are probably responsible for much of the distribution to different parts of the same tree as well as to different trees. Men and domestic animals are the greatest disseminators. Birds may at times be responsible for distribution but where the inspection work is close and frequent, infections are invariably detected in early stages and destroyed before birds have any appreciable opportunity to come in contact with the infected portions.

In connection with the field work the varying appearance of canker was noted at the different seasons of the year, as well as its peculiarities upon different citrus host plants.

Laboratory Work

The necessity for studying citrus canker upon its host plants was self-evident. Such work could not be conducted in the groves because of the danger of the disease being further disseminated. Experiments under grove conditions with a disease of such virulence would have been foolhardy in the

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extreme. One of the first undertakings, in connection with the Tropical Laboratory at Redland, was the construction of a screened cage (Plate XVI) in which inoculated and infected plants could be kept under observation. The framework was made of substantial timbers, securely braced and well anchored as a precaution against its being destroyed by tropical storms. Sides and top were doubly screened, on the outside with galvanized netting and on the inside with bronze screen of fine mesh. This screening, coupled with a moat about the base, rendered the cage practically insect-proof. Within, the cage was divided into two divisions, separated by an aisle (Plate XVII). Each division was divided into compartments or rooms, each room being separated from other rooms and the aisle by screened partitions. The cage is kept securely locked at all times and no one is permitted to enter the cage or any portion of it except under suitable sanitary precautions. Later on, another screened cage was constructed in which to keep a stock of young citrus trees prior to their inoculation. In connection with the experiments carried on in the screened cage, records of humidity and temperature are kept by means of a hygrothermograph installed in a standard instrument shelter near at hand.

Within the laboratory the usual equipment for bacteriological and pathological work was installed. As soon as facilities and materials were available media were prepared upon which to grow the canker bacteria. Both liquid and soluble media were used, the media being solidified by the addition of a jelly-like substance known as agar.

The citrus canker organism, *Bacterium citri*, was isolated from infected leaves, fruit and twigs collected in various groves. Owing to the nature of the disease the infected portions of the citrus plant are frequently invaded by saprophytic organisms. Many of these grow on artificial media in a manner very similar to the canker bacteria and can be distinguished from the latter, either by their manner of growth on media or under the microscope, only with difficulty. In order to determine positively which of the cultures secured from infected tissue were *Bacterium citri* it was necessary to inoculate citrus trees with all which resembled the canker organism. Potted grapefruit trees, with which every precaution had been taken to prevent danger of previous infection, were used for this purpose on account of their susceptibility. A separate tree was used for

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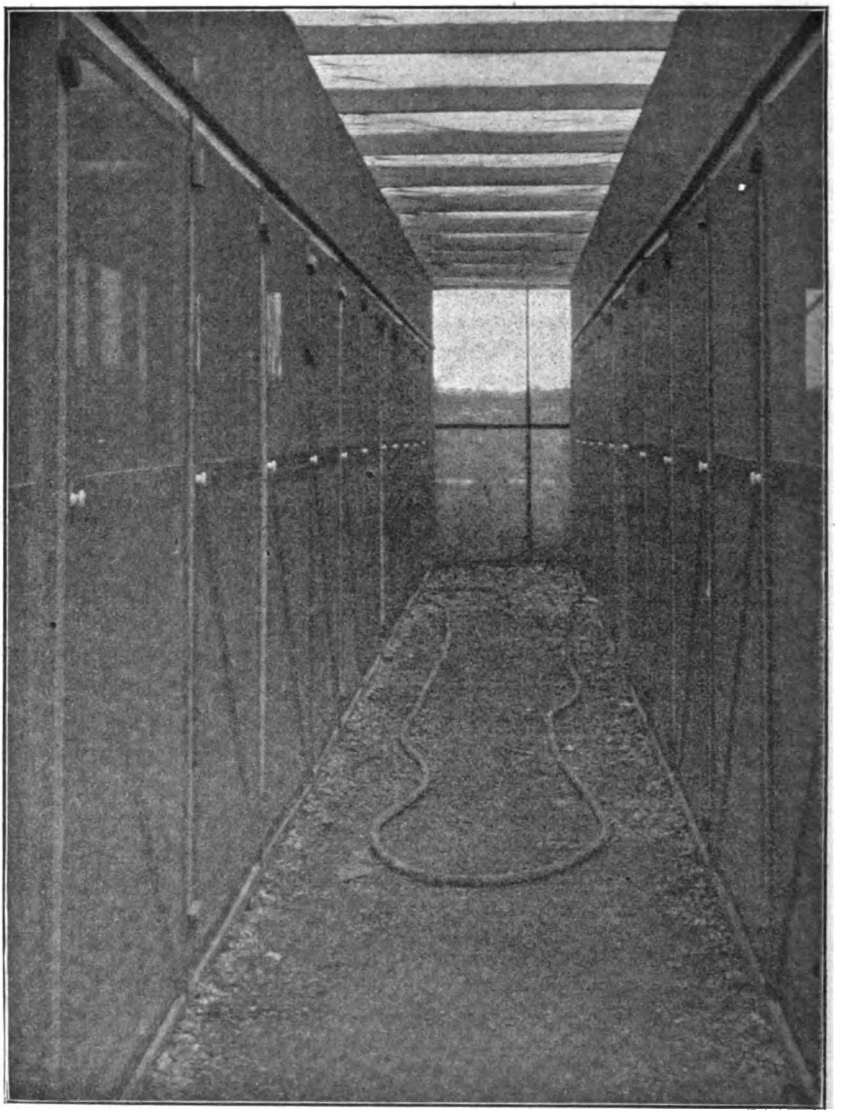

Plate XVII.—Interior of the screened cage, showing central aisle and doors to screened rooms on each side (Original).

each culture. The trees were inoculated by spraying them with a small atomizer containing a suspension of the culture in sterile distilled water*. After inoculation the entire tree was covered with a lamp chimney plugged with cotton at the upper

*Distilled water for use at the laboratory has been generously donated by the Ice, Light and Power Co. of Florida City.

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end (Plate XXI, 1). In some instances canvas frames were used to prevent the trees from drying off and during hot summer weather both lamp chimneys and frames were used. These were employed to prevent the trees from drying, as the disease develops most rapidly when the humidity is high. The coverings were allowed to remain over the trees for several days in order to give the organisms time to gain entrance into the tissues of the inoculated plants.

No visible evidences of infection were observed in the first tests until thirty to forty days after inoculation, probably due to the cool weather prevailing at that time. Subsequent inoculations gave quicker results. Inoculated trees are kept in the screened cage and frequently inspected and upon infections appearing which can be positively identified as citrus canker they are removed to other compartments used exclusively for infected trees.

Tests have been made in the laboratory of the effect of various disinfectants upon the canker organism. Liquid disinfectants were tested by transferring canker organisms from pure cultures into one cubic centimeter of the disinfecting solution, then after a recorded time, introducing a loop of this solution, containing the organisms in suspension, into a sterile Petri dish and pouring on the agar. In some cases the liquids were poured directly on the organisms in the cultures instead of introducing them into the one cubic centimeter of solution. Cultures of different ages and from different sources were used and the pathogenicity of the cultures frequently tested by inoculation of grapefruit seedlings. All experiments were checked by the use of untreated cultures.

Gases were tested by exposing Petri dishes containing the organism to the gas in a fumigating box (shown in the foreground, Plate XVI). In some cases the organisms were sprayed onto the surface of the glass and allowed to dry. The plates containing the dry organisms were then fumigated and the agar poured into them. If the organisms were killed by the gas used for fumigating no growth occurred on the agar, but when they were not killed colonies would grow out in the agar within a few days. In other cases the agar was poured into the plates and allowed to harden, then the organisms were sprayed on the surface and the plates were fumigated. In all cases the plates were kept for at least one week after fumigation and observed for signs of growth.

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Reference to the results of various experiments is made from time to time in subsequent paragraphs of the present

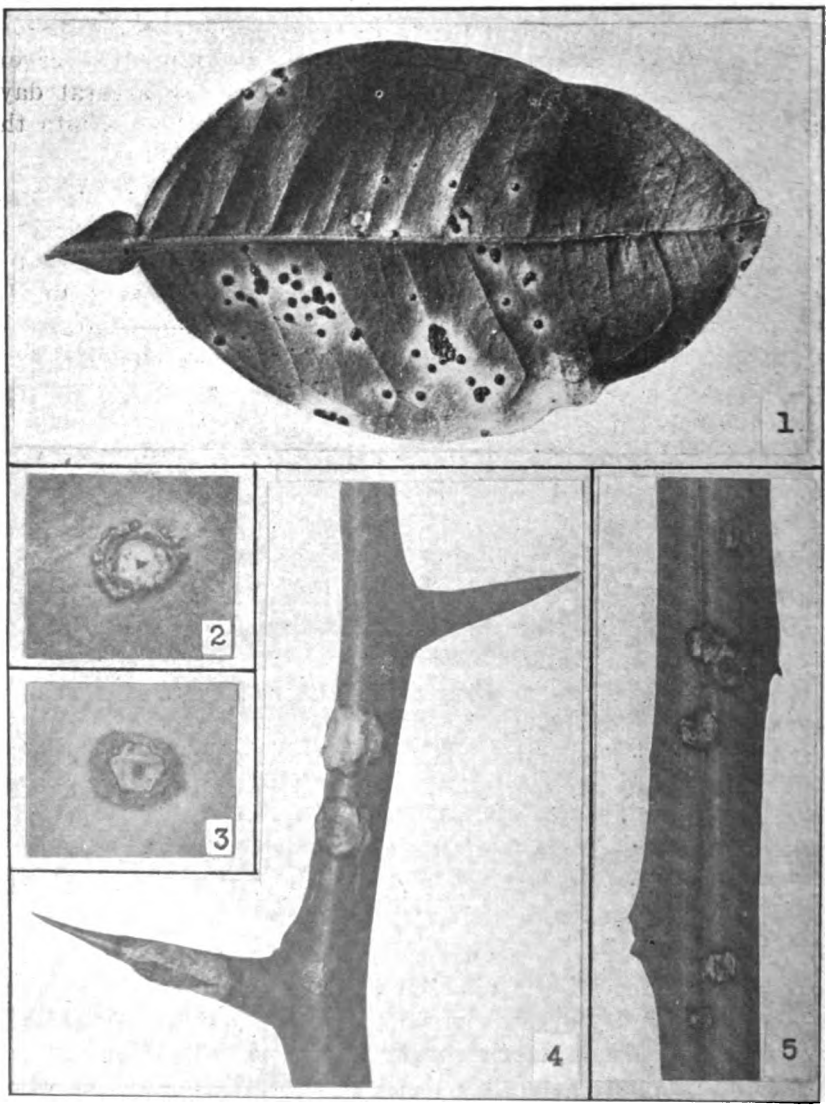

Plate XVIII.—Citrus canker: (1) lower surface of grapefruit leaf infected with canker showing the circular raised spots surrounded by yellow halos; (2) mature canker infection on upper surface of grapefruit leaf, showing crater-like appearance; (3) lower surface of leaf shown in (2); (4) infection on twig and thorn of Citrus trifoliata, showing longitudinal splitting of the membrane; (5) infections on grapefruit twig. No. 1, natural size; Nos. 2, 3, 4 and 5 enlarged three diameters (Original).

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paper and the results of experiments now under way but incomplete will be presented in future reports.

Hosts

Citrus canker has been found on almost all kinds of citrus plants, and it is likely that none of them is immune, although they vary in their susceptibility. The artificially infected plants in the screened cage at the laboratory varied in susceptibility in the following order: Pomelo (grapefruit), ponderosa lemon, key lime, Citrus trifoliata, sour orange, tangelo, sweet orange, tangerine, king orange, mandarin-lime, and kumquat. The grapefruit, ponderosa lemon, Citrus trifoliata, sour orange and tangelo varied but little in susceptibility. The mandarin-lime and kumquat seemed to be very resistant as but few infections developed on them and these developed very slowly. The disease has also been reported on the naval orange, mandarin, satsuma, common lemon, and rough lemon. It has not been reported on any non-citrus plants. Berger* observed that citrus plants varied in susceptibility in the following order: Pomelo (grapefruit), Citrus trifoliata, key lime, naval orange, sweet orange, Satsuma, tangerine, mandarin, king orange and lemon.

Infections on Mature Fruit

Ripe grapefruit, oranges, tangerines, satsumas and kumquats were inoculated in the laboratory by spraying them with an atomizer containing a suspension of the canker organisms in distilled water and then keeping the inoculated fruits in a saturated atmosphere. These fruits never developed canker lesions, although grapefruit seedlings inoculated with organisms from the same cultures showed infections. It appears very improbable that the canker lesions will develop upon ripe citrus fruit after it is picked from the trees, but such fruit can, nevertheless, serve as mechanical carriers for the organisms just as other articles, such as clothing, tools, etc., do. Mature fruits with numerous canker lesions on them have frequently been encountered on infected trees but the lesions in such cases apparently developed while the fruit was still immature or at least in the process of growth and maturity.

*Berger, E. W.—Citrus Canker in the Gulf Coast Country, with Notes on the Extent of Citrus Culture in the Localities Visited. Fla. State Hort. Soc. Proc., 1914, p. 122.

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Distribution

The disease was probably introduced into the Gulf States on nursery stock from Japan. According to Berger, Stevens and Stirling* and Edgerton and Garrett** the first shipments of infected citrus nursery stock were planted at Alvin and Port Arthur in Texas, at Lafayette in Louisiana, at Wiggins in Mississippi and at Monticello in Florida. Canker also occurs in Alabama. According to Fawcett† it is not known to occur in California. In a paper read before the Citrus Seminar at Gainesville on October 6, 1915, Dr. W. T. Swingle reported finding the disease in Japan, the Philippine Islands and China. After making a thorough study of the disease in parts of these countries which he visited he concluded that it had been introduced into all of them, namely, that it was not endemic. Specimens of citrus canker have been received by Stevens from Australia, Java and Singapore, indicating that it occurs in those countries. The disease is also now known to be present in certain parts of South Africa.

Economic Importance

The citrus canker disease is undoubtedly the most serious disease of citrus plants which has yet come to the attention of either growers or authorities. Swingle stated that in Japan it causes almost a total loss of the Washington Navel crop during warm moist seasons. According to Stevens‡ it is one of the worst plant diseases that has appeared in Florida, and Wolf§ states that it is the most destructive malady affecting species of citrus.

While there is a marked tendency on the part of the public generally to regard canker in much the same light as one thinks of whitefly, purple scale, die-back or other insects or diseases affecting citrus, those who have had first-hand experience with the disease are convinced that it is far more destructive than any trouble with which the citrus growers generally are familiar. For those who have seen the destruction wrought by citrus canker in its advanced stages the conviction has been

*Berger, E. W., Stevens, H. E., and Stirling, Frank.—Citrus Canker II. Fla. Agr. Exp. Sta. Bul. 124, p. 28 (1914).

**Edgerton, C. W., and Garrett, J. B.—Citrus Canker. La. Agr. Exp. Sta. Circ. 15, p. 3 (1916).

†Fawcett, H. S.—Citrus Diseases of Florida and Cuba Compared With Those of California. Cal. Agr. Exp. Sta. Bul. 262, p. 169 (1915).

‡Stevens, H. E.—Citrus Canker III. Fla. Agr. Exp. Sta. Bul. 128, p. 3 (1915).

§Wolf, F. A.—Citrus Canker. Journ. Agr. Res., Vol. VI, No. 2, p. 69 (1916).

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unavoidable that the disease will, if not eradicated, completely ruin the grapefruit, lime and round orange industries of Florida and seriously interfere with the successful production of other citrus fruits. On trees where the infection is of a few months' standing all fruits are infected and all infected fruits are culls of the poorest sort, entirely unmarketable (Plate XX, 3). A tree which cannot produce marketable fruit is of course worthless and even if the disease did not destroy the tree itself the loss to the grower would be complete. Aside from ruin of the fruit, however, infected leaves drop prematurely, weakening the tree and even killing it in time. Infections on the twigs frequently girdle the latter causing the death of all parts beyond the infection. Even when the twigs are not completely girdled the trees are injured by the resulting interference with the passage of food and water. Artificially inoculated trees in the screened cage have all been more or less injured by the disease and many have lost their leaves. Two of the grapefruit seedlings have been killed and others have been so seriously injured by the disease that they cannot survive (Plate XXI, 3).

SYMPTOMS

The symptoms of citrus canker on various host plants and during different seasons of the year, together with a comparison with other citrus diseases, have been discussed and illustrated by the writer* and only a summary, together with observations made since the preparation of that article, will be given here.

The disease attacks the twigs, leaves, fruits, thorns and occasionally the larger limbs. The symptoms are very similar on all of these parts. Canker makes its first appearance as a small pimple-like watery dot, resembling a large oil gland (Plate XVIII, 1). On the leaves both the upper and lower surfaces become infected sooner or later and the disease has a very similar appearance on both surfaces. It may appear on either surface first or on both surfaces simultaneously. The pressure from within becomes so great that the outer membrane of the infected portion ruptures exposing a corky mass. The ruptured membrane sometimes persists but is usually sloughed off sooner or later. The corky tissue is at first slightly pink in color but soon it begins to darken and sometimes becomes almost black. Just outside of the central corky tissue where the disease is invading healthy tissue is a yellowish-brown, oily,

*The Quarterly Bulletin, Vol. I, No. 1 (1916).

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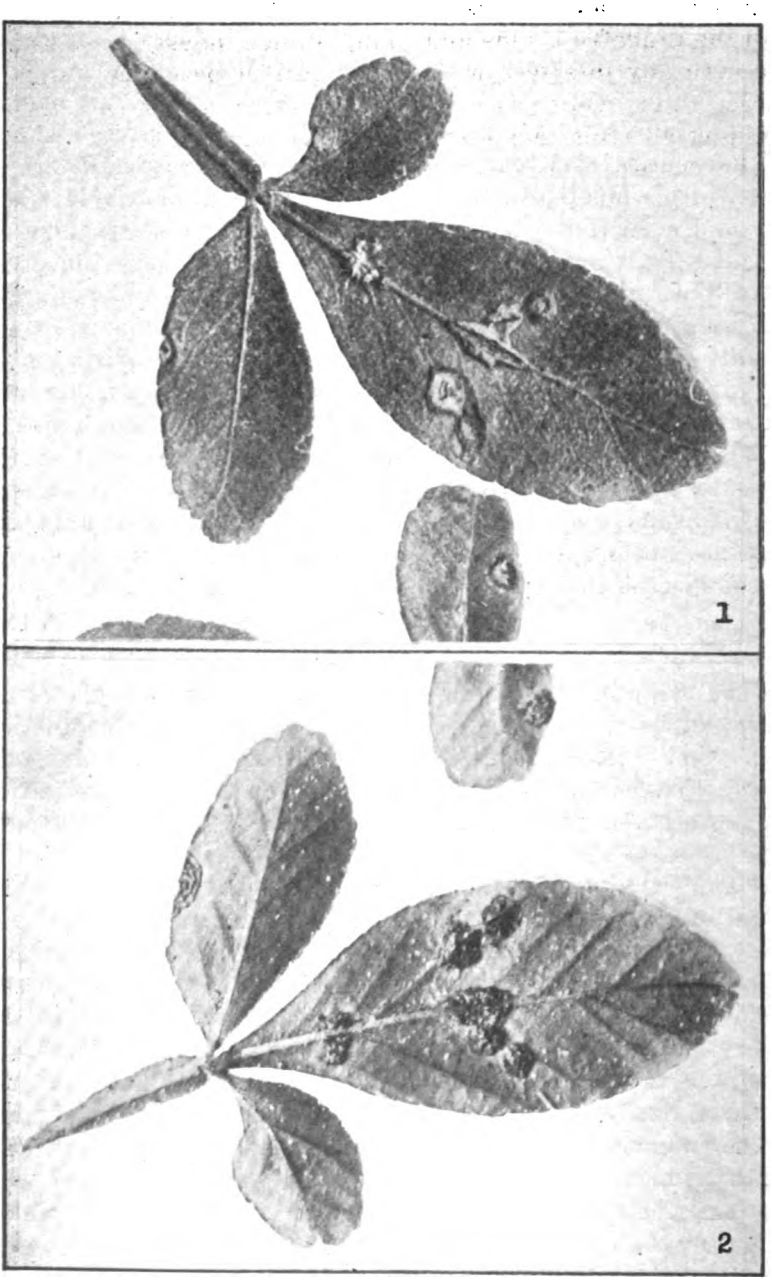

Plate XIX.—Canker infections on leaves of Citrus trifoliata produced by spraying with canker bacteria from pure cultures; 1, upper surface; 2, lower surface; all enlarged three times (Original).

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glazed, translucent zone which varies somewhat in color and size under different conditions and upon different host plants. This zone may be surrounded by a yellow halo, but very frequently this halo is inconspicuous or wanting. The spots usually mature when they reach a diameter of one-fourth to one-half an inch. On the leaves a hollow is frequently formed in the center surrounded by a raised zone giving to the spot a crater-like appearance (Plate XVIII, 2 and 3). The central part of the diseased portion may drop out leaving a hole through the leaf. Typical canker spots are circular in outline, more or less elevated, and may occur singly or in groups. When in groups they often fuse forming larger more or less irregular areas. On the fruits canker may cause gumming in severe cases (Plate XX, 3). The disease does not penetrate very deeply into the rind but may pave the way for other organisms which rot the fruit. On the twigs it only penetrates to the wood. On the inoculated twigs, thorns, and leaves of Citrus trifoliata it developed in a very interesting manner. On the twigs and thorns it made its first appearance as a dark green watery blister which gradually increased in size until it caused a longitudinal splitting of the outer membrane. As it advanced the fissures made by this splitting became broader, and more splitting took place mostly in a longitudinal direction. The cankerous tissue consisting of yellowish-brown corky cells could be distinctly seen bulging up between the edges and cracks (Plate XVIII, 4). On the leaves the first evidences of infection were very similar to those on the twigs and thorns. The splitting of the outer membrane was more irregular than in the case of the twigs and thorns. No yellow halo was found at the edge of the canker infections (Plate XIX). The grayish membrane which covered the cankerous tissue seemed to persist longer in this host than in most other hosts.

ETIOLOGY

Citrus canker was at first thought to be of fungus origin and Stevens* and Wolf and Massey** succeeded in producing canker from what they thought were pure cultures of a fungus which they classified as a *Phoma* or *Phyllosticta*. Miss Hasset demonstrated that it was caused by a bacterium which appeared

*Berger, Stevens and Stirling, l. c., p. 39.

**Wolf, F. A., and Massey, A. B.—Ala. Agr. Exp. Sta. Circ. 27, pp. 99-100 (1914).

†Hasse, C. H.—Pseudomonas citri, the Cause of Citrus Canker. Journ. Agr. Res., Vol. IV, No. 1, pp. 97-100.

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to be a new species and which she called *"Pseudomonas citri."* Stevens* had come to the same conclusion regarding its being

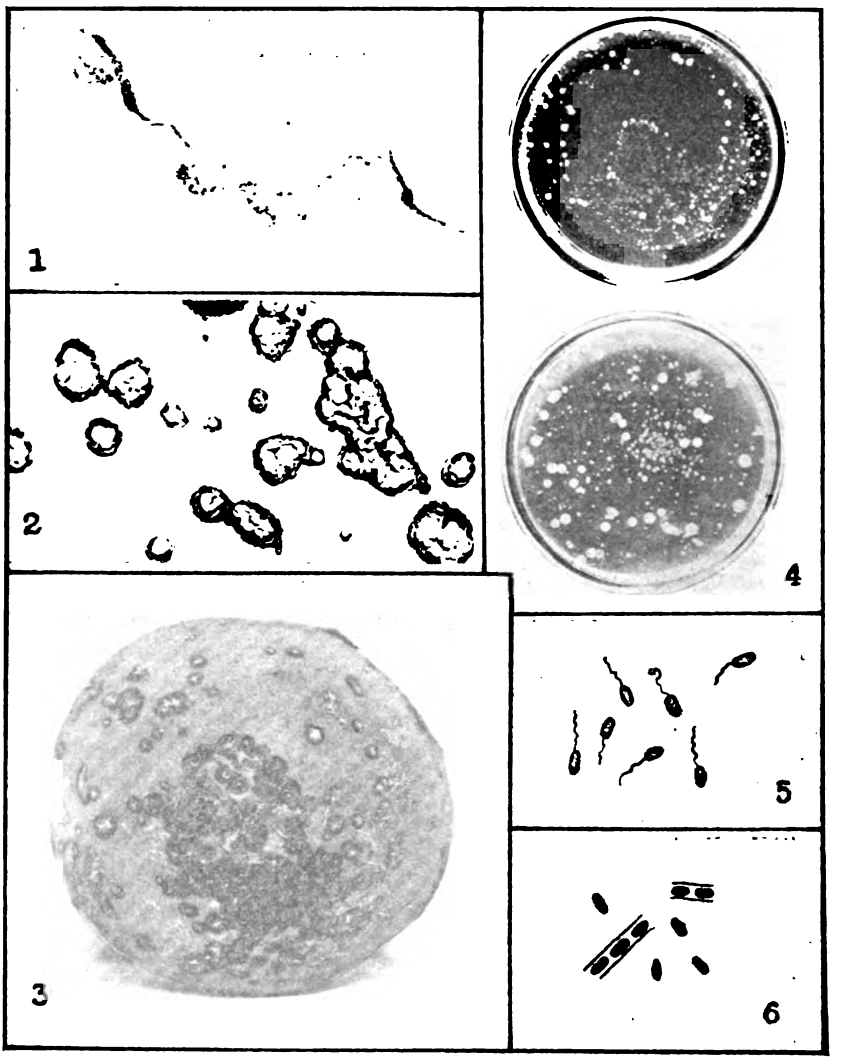

Plate XX.—Citrus canker: 1, lower edge of grapefruit leaf showing infection on edge of bite made by an insect; 2, infection on green grapefruit; 3, young grapefruit infected with canker with the gum oozing out in large masses; 4, Petri-dish cultures of Bacterium citri on nutrient agar; 5, canker bacteria showing flagellae (diagrammatic); 6, canker bacteria from one-day culture on nutrient agar, stained with carbol fuchsin. Nos. 1 and 2 enlarged three times; No. 3 natural size; No. 4 reduced one-third and Nos. 5 and 6 magnified 1,000 times (Original).

*l. c., p. 12.

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caused by a bacterium just before Miss Hasse's paper appeared. Wolf* and Stevens** accounted for their initial infections by the fact that their cultures were not pure and later confirmed the work of Miss Hasse.

The bacterium *Pseudomonas citri* Hasse, or *Bacterium citri* if Smith's classification is accepted***, described by Miss Hasse as the cause of citrus canker has been repeatedly isolated from leaves, twigs, and fruit of various citrus plants and has produced the disease in over 75% of the inoculated citrus trees. The organisms have been repeatedly isolated from these artificially produced cankers and the disease has been reproduced with the reisolated organisms. This leaves absolutely no doubt as to the cause of the disease. The artificially produced cankers do not differ from those found in the groves. Some variations were observed such as variations in the sponginess of the cankered tissue, in the presence or absence of a yellow halo, etc., but these differences were also observed in natural infections. No fungi were used in any of the inoculations and typical citrus canker developed without the presence of any fungi other than ordinary saprophytic moulds. Although fungi may assist in disintegrating the tissue killed by the canker organisms, they do not enter into the cause of the disease.

Description and Cultural Characteristics of the Organism

Bacterium citri is typically a rod-shaped, uniflagelate organism rounded at both ends (Plate XX, 5). The flagellum is a whip-like appendage attached to the polar end. The bacterium measures 1.5 to 2 by .5 to .75 microns (15,000 to 20,000 placed end to end would measure about one inch) and may occur singly or in chains of several units. The bacterium is embedded in a jelly-like substance which probably gives it its viscidity. It stains readily with carbol fuchsin and methylene blue (Plate XX, 6).

When plated out on beef agar in the culture room (about 80°F) the colonies become visible at the end of 24 hours. They make their first appearance as small glistening dots and increase in size quite rapidly becoming conspicuous in a few days. They are circular in outline with an entire margin and a glistening slightly raised surface (Plate XX, 4). The interior of the colony has a fine granular structure. The color is light yellow by reflected light and bluish by transmitted

*l. c., p. 74.
**l. c., pp. 12-13.
***Smith, E. F.—Bacteria in Relation to Plant Diseases I, p. 166 (1905).

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light. On agar slants, growth becomes visible in 24 hours in the culture room. The growth follows the slant, is slightly raised with a moist glistening surface and has a dull yellow color. The outline of the colony is wavy (Plate XXI, 2). In beef bouillon there is a slight clouding after 24 hours. This increases as the culture becomes older and finally a yellow ring is formed at the surface. On potato plugs a slightly raised bright yellow growth is formed with a narrow white margin on the portion of the potato just outside of the colony. As the colonies become older this zone becomes less prominent and the growth becomes more vigorous and finally covers the entire plug. Other cultural characteristics are discussed by Hasse* and Wolf**.

PATHOGENICITY

Citrus canker was first considered to be infectious by Stevens† and Stirling‡ infected a grapefruit seedling by drawing an infected leaf, previously soaked in water, between the thumb and forefinger and then drawing a leaf of the seedling between the same fingers. Canker infections resulted in eight days. The pathogenicity of *Bacterium citri* was first observed by Miss Hasse, then by Stevens and later by Wolf. It has been repeatedly tested by the writer. Inoculations were made by introducing the organism into pricks made with a sterile needle and by spraying the trees with a suspension of the bacteria in sterile distilled water and keeping a film of water on the inoculated parts for at least 24 hours. The trees are just as easily infected by either method, but the former is preferable for testing the pathogenicity of different cultures. Conspicuous infections can be readily obtained in three to ten days by introducing many of the organisms directly from agar cultures into the pricks made with a sterile needle (Plate XXII). Check trees were sprayed with sterile distilled water or punctured with a sterile needle without introducing the organism. No canker infections ever developed in any of the checks.

Infections became visible in from three to ten days when the inoculations were made during the summer, and when they were made during the winter infections did not become visible until thirty to forty days after inoculation. In one instance

*l. c.

**l. c.

†Stevens, H. E.—Citrus Canker. Fla. Agr. Exp. Sta. Bul. 122, p. 117 (1914).

‡Tenny, L. S.—The Citrus Canker Situation in Florida. Fla. Growers' & Shippers' League Bul. 1, p. 15 (1914).

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the incubation period was 108 days and in another it was 136 days but cases of this kind were uncommon. There are cases on record where the disease has broken out one year or longer

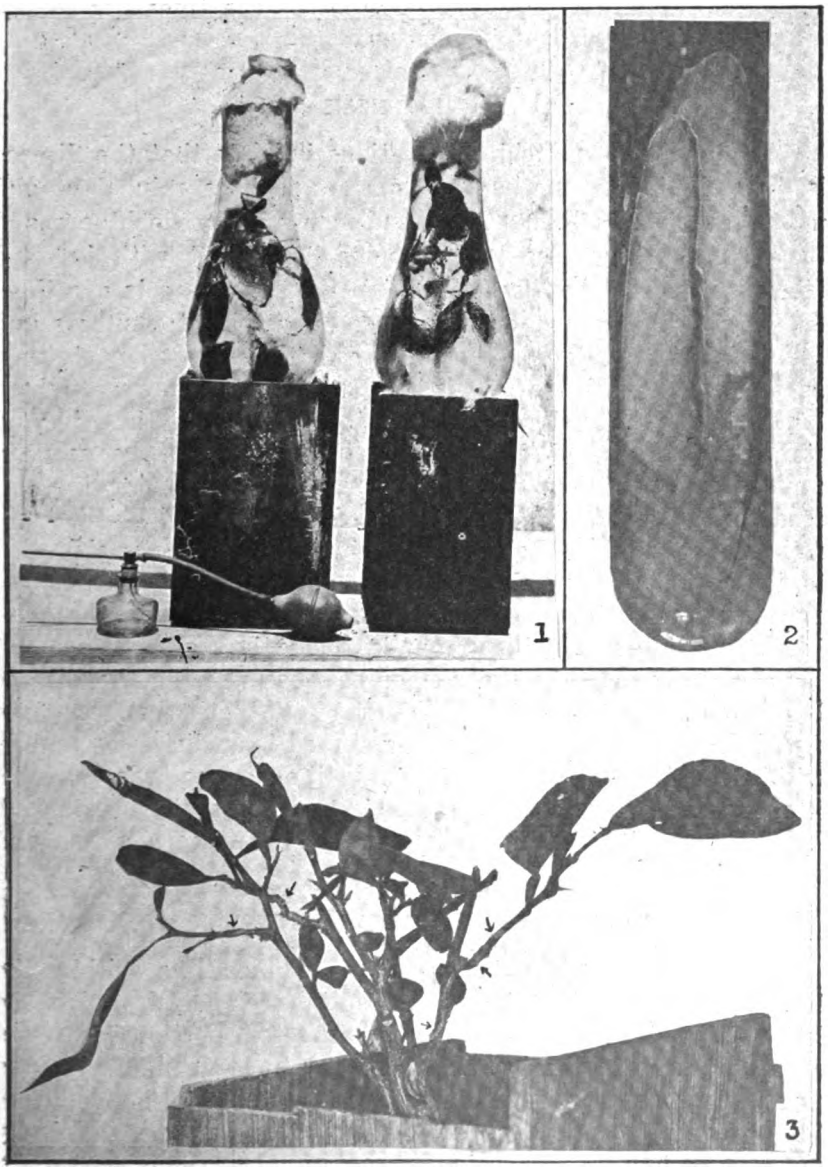

Plate XXI.—Citrus canker: 1, grapefruit seedlings enclosed in lamp chimneys after being inoculated by spraying with canker bacteria suspended in distilled water; 2, a pure culture of Bacterium citri on nutrient agar; 3, infected grapefruit seedling with twigs girdled by the disease (Original).

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after the last infection was burned and the opportunities for infection from outside were few. In most of these cases the infections appeared soon after a new growth was put out. It is thus apparent that the condition of the trees has an influence on the period of incubation.

Pathogenesis

As stated above, field observations indicate that the disease is disseminated by mechanical carriers such as rain, dew, and animal carriers including birds and men. Farm machinery and tools, or anything else which comes in contact with infected trees, may carry the disease. When the canker spots are thoroughly wet the canker bacteria ooze out in great numbers and the droplets of water on the surface of the diseased parts may be teeming with them. This may be easily demonstrated by taking drops of water from infected parts after a rain and staining with carbol fuchsin. Such mounts will be seen to contain many canker bacteria when examined under the microscope. The bacteria are embedded in a sticky jelly-like substance and readily adhere to anything which may come in contact with them, thus being easily transferred from one place to another. When these droplets of water dry down in the gelatinous substance which surrounds them the bacteria are not easily detached. Thus the danger of disseminating the disease is much greater when the plants are wet than when they are dry. The organism has been transferred long distances mainly within the tissues of the host while the disease was invisible to the naked eye or so inconspicuous as to be easily overlooked. In this way it is frequently carried in nursery stock and budwood.

Life History of the Pathogen

The bacteria which cause citrus canker live within the tissues of the host and produce substances which cause the latter to disintegrate. When the infected portions are wet with dew or rain the bacteria ooze out in large numbers in a gelatinous mass with which they are invested. In this condition they are easily transported to healthy tissue where they may cause infection. Stevens, in announcing the results of his investigations, at the Citrus Seminar at Gainesville in October, 1916, reported that he had found the canker bacteria alive and virile in soil taken from the site of an infected tree destroyed

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nine months previously and that canker bacteria had survived for a period of seventeen months in otherwise sterile soil in his laboratory, producing typical canker infections on inoculated grapefruit seedlings at the end of this period.

Mention of an experiment by the writer with infected glade and red soil was made in a previous article*.

Effect of Various Agencies Upon the Canker Organism

Stevens† found that canker organisms are killed by a 5 minute exposure to temperatures ranging from 55 to 60 degrees C. (132 to 140 degrees Fahrenheit), and according to Wolf** the thermal death point is between 58 and 70 degrees Centigrade.

Tests of the effect of various gases and solutions upon the canker organism are being made at the laboratory. The following substances were and are being tested: Formaldehyde gas, formaldehyde solution, hydrocyanic-acid gas, bichloride solutions in water and in dilute denatured alcohol, solutions of borax in water and of borax and glycerine in water, carbolic acid, copper sulphate, potassium permanganate, and coal-tar products. These tests are being repeated with cultures of various ages, upon various media, and with canker bacteria obtained directly from diseased tissue. The writer was assisted in the tests with borax by Mr. J. Matz, and with the tests with bichloride, copper sulphate, carbolic acid and potassium permanganate, etc., by Dr. E. S. Cogan, agents of the Bureau of Plant Industry, United States Department of Agriculture. The canker bacteria have been killed in one minute or less in all tests made with bichloride in water 1-1000, bichloride in dilute denatured alcohol (10%) 1-1000, formaldehyde (2% solution), and carbolic acid (5% solution). They were also killed by a one-half hour exposure to formaldehyde gas, the gas being made with 10 cc of formaldehyde (40% solution) and 5 grams of potassium permanganate to every 13 cubic feet of space.

Pathological Histology

According to Miss Hasse‡ the cells of the host become filled with the bacteria, which exert a stimulating influence on them causing them to enlarge and resulting in the raising of the

*Quarterly Bulletin, Vol. I, No. 1, p. 9 (1916).
†Stevens, H. E.—Citrus Canker III. Fla. Agr. Exp. Sta. Bul. 128, p. 17 (1915).
**l. c., pp. 77-78.
‡l. c., pp. 98.

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diseased tissue above that of the normal leaf surface. In later stages some of the cells disintegrate and lesions are formed. The cell contents seem to be more vigorously acted upon than the cell walls and in due time their contents become exhausted. The remaining cell walls become suberized and constitute the cankerous growth characteristic of the disease. Wolf* states that "contrary to Hasse's observations, the bacteria teem around and between the host cells, being present in especially large numbers in the intercellular spaces. When the organism occurs within the cells, one is led to conclude, since they appear to be confined to such cells, that entrance was effected after some mechanical rupture of the host cells." He is of the opinion that infection takes place only through stomata or injured tissue, but Stevens** thinks that infection may take place directly through the epidermis as the leaves were just as readily infected from the upper surface as they were from the lower.

Ecology of the Disease

The occurrence, prevalence, and severity of citrus canker are affected very much by various factors. Two of the factors which seem to have the greatest effect are weather conditions and vitality and vigor of the host.

Weather Conditions

Field and laboratory studies of the disease have demonstrated that it is much more prevalent and severe, and that the incubation period is much shorter during the summer than during the winter. In Florida the humidity and temperature are usually high during the summer, humidity averaging from 50% to 95% and temperature from 65 to 95 degrees F. at the Tropical Laboratory. Local showers are very prevalent and frequently follow one another with such rapidity that the trees do not dry off for long periods of time. During the winter the opposite conditions prevail, the air being dry and cool and showers few with long intervals between them. At Redland the temperature usually ranges from 45 to 85 degrees F. and the humidity from 20% to 90%. Swingle learned that the disease was much more destructive and prevalent in Japan during warm moist seasons than it was during cool dry ones.

*l. c., pp. 80-81.
**l. c., p. 13.

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Vitality and Vigor of the Host.

The vitality and vigor of the host have a marked effect upon the prevalence and severity of citrus canker as well as upon the period of incubation. The disease is much more prevalent and severe upon trees which are in an otherwise thrifty, healthy growing condition than it is upon those which are unthrifty and unhealthy. The period of incubation is much longer when the trees are unthrifty and unhealthy and the disease may remain on such trees in a dormant condition without becoming visible for long periods of time. Anything, such as cultivation and fertilization, which will bring out a vigorous thrifty growth on trees of this kind will also cause the disease to appear, if present, in a visible and typical form, and thus facilitate its discovery and make possible its eradication.

CONTROL

Ever since citrus canker was recognized as a new disease numerous attempts have been made to solve the problem of controlling it.

Since many fungus diseases can be checked by spraying, most of the first attempts at control were applications of various fungicides as the disease was then thought to be of fungus origin. Bordeaux mixture, iron sulphate, ammoniacal copper carbonate, soluble sulphur and other mitxures were tried but they all failed to check the disease.

So-Called "Canker Cures"

Many attempts have been made to cure the disease, mostly by parties unfamiliar with the exact methods of the bacteriologist and hence prone to draw immature conclusions. No experiment of this kind has yet shown successful results.

At the laboratory careful consideration has been given to all plans, methods or materials which have been submitted by private parties as "remedies" for citrus canker. In the case of many of these a knowledge of their nature, coupled with the most perfunctory knowledge of bacteria, showed them at once to be useless. Those which gave even a remote promise of possessing any merit were carefully tested but in no case has any plan or preparation been found to possess any value.

Living canker bacteria have been found in all spots treated with supposed cures at the Tropical Laboratory as well as in canker material sent to the laboratory which was thought to

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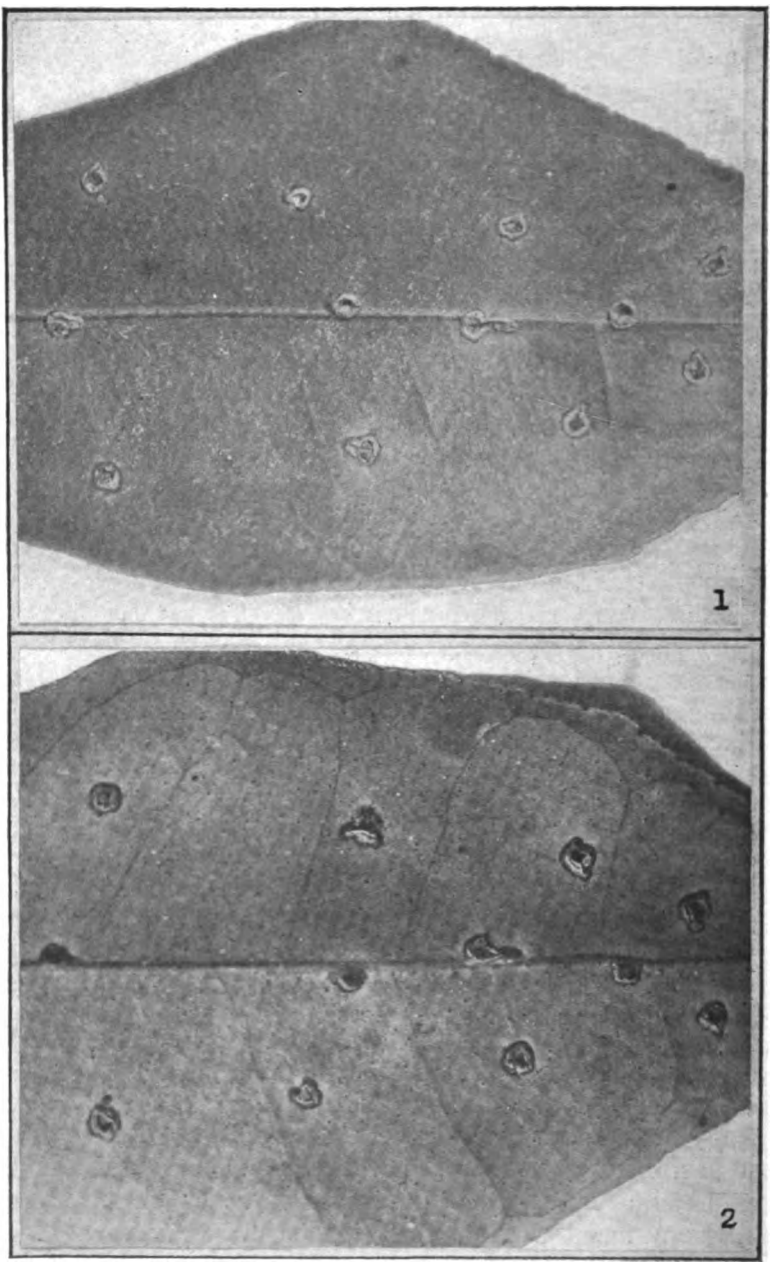

Plate XXII.—Twelve canker infections on a grapefruit leaf produced by introducing canker bacteria into needle pricks made with a sterile needle: 1, upper surface of leaf; 2, lower surface; all enlarged three times (Original).

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have been cured. Most of these so-called canker cures are in the nature of liquids which are thought to cure canker by spraying them on the diseased trees. Many substances will change the appearance of canker spots and may cause the dead tissue or entire leaf to drop, but do not kill the canker organisms within the tissues. Even if a substance will kill the canker organisms just as soon as it comes in contact with them, it may be absolutely of no value as a canker cure when sprayed on the infected trees, as the bacteria within the tissues may remain alive after the treatment. For instance, a solution of bichloride in water 1-1000 will kill the canker organisms with which it comes in contact but living colonies of *Bacterium citri* can be readily isolated from infected fruits, leaves, and twigs which have been repeatedly dipped in the solution. Every spot infected with citrus canker contains millions of canker bacteria, each capable of reproducing the disease under favorable conditions and it would be extremely difficult if not impossible to find any substance which would kill all of them without seriously injuring or killing the infected plants.

The disease has been thought by some to be carried in the sap of a tree and various salts including copper sulphate and iron sulphate have been applied to the roots with the hope that they would be taken up by the sap and cure the disease. None of these treatments has checked the disease and it is very unlikely that any substance can be found that will be taken up by the sap and carried to the infected parts and kill all of the canker organisms without killing or seriously injuring the treated plants.

Attempts have been made to cure infected trees by cutting them back, by burning out infected portions, and by pruning back severely, often to the main trunk and a few large limbs, then treating with some disinfectant such as strong Bordeaux paste, solutions of bichloride in alcohol, and carbolinium. None of these treatments was successful as the disease reappeared on most of the treated trees soon after they put out new growth.

Doryland* conducted some experiments on infected nursery stock in the Philippine Islands, using formaldehyde sprays and cutting back in some instances. Soil treatment was also included in the tests. Some success is claimed for the method in preventing spread of the disease but too short a time had

*Doryland, E. D.—Citrus Canker Investigations at the Singalong Experiment Station. Phil. Agr. Rev., IX, p. 133 (1916).

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elapsed between the treatment of the trees and the writing of the report to be certain as to the final results.

Exclusion

Prior to the adoption of quarantine rules by the State Plant Board, under authority of the Florida Plant Act of 1915, the principal means of dissemination of citrus canker was by the shipment and movement of citrus nursery trees, either from infected nurseries or nurseries which had been exposed to infection.

On January 1, 1915, the Federal Horticultural Board placed a quarantine on all importations of citrus trees and plants, prohibiting their importation to the mainland of the United States. The introduction of all citrus nursery stock into Florida has been prohibited by the State Plant Board, thus eliminating the chances of any further introductions of the disease from outside sources. In case of infection centers within the State the rules of the Board prohibit the planting of citrus trees within one-half mile of a canker-infected property and prohibit the movement of any citrus tree located within one mile of the boundaries of an infected property. Through the compliance with these rules by the citrus growers in the affected sections, dissemination, even locally, by movement of citrus plants has apparently been stopped, for no case of such dissemination has yet come to light.

Eradication

It was early recognized that the most economical way to handle citrus canker would be to completely eradicate it. As long as the disease exists within the State it will be a continuous expense to the growers of citrus fruits and to the State as a whole as it threatens to greatly cripple if not to completely destroy the citrus industry if allowed to develop unchecked. Even if a remedy were found there would always be a certain amount of expense connected with its application which would greatly decrease the profits of the industry. The only practical way by which the disease can be controlled at the present time is to inspect all of the citrus trees as frequently as possible and completely destroy infected trees as soon as they are found. The infected trees are destroyed by burning them where they stand with an oil spray, using the same kind of an outfit which is used in applying a fungicide. The ground around the tree is

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also burned for a distance of three feet beyond the utmost spread of the branches. As an additional precaution to kill any canker organisms which may have been washed into the soil and survived the burning, the ground around the burned tree is saturated with a 2% solution of formaldehyde.

All of the work of inspecting and destroying infected trees is carried on by inspectors attired in special suits and under the most rigid precautions which can be devised with reference to disinfection and other sanitary precautions. The disease has already been eradicated from over half of the properties in Florida in which it was found to occur and there seems to be no doubt that a proper continuation of these methods will result in final eradication of the scourge from all of the infected areas.

THE PINEAPPLE BLACK WEEVIL

ANOTHER PEST LIKELY TO BE INTRODUCED INTO FLORIDA

WILMON NEWELL

The introduction of citrus canker into Florida has brought home to thousands of citizens the importance of protecting our State against the insects and plant diseases which occur in foreign countries, and sometimes even in countries lying very close at hand. The spiny citrus white fly, a pest probably as destructive to citrus plants as even citrus canker and attacking many non-citrus plants as well, occurs in the Bahamas, Cuba and Jamaica. The Morelos fruit worm and the pink bollworm of cotton occur in Mexico, the avocado weevil in Central America and the Mediterranean fruit-fly in the Bermudas and in nearly all the tropical and sub-tropical countries from which Florida citizens are likely to import trees and plants. Against all of these pests, and many others, the State Plant Board is maintaining as efficient and thorough a quarantine as its resources will permit.

Now comes information regarding a destructive insect of pineapples which occurs in the Above Rocks District of Jamaica, where fully 75 per cent. of the pineapple crop was destroyed by it during the year which ended July 21, 1916. The pest is a black weevil which has been described* by Dr. Guy A. K. Marshall of the British Museum of Natural History as *Metamasius ritchiei*. Through the courtesy of Mr. Archibald Ritchie,

*Bulletin of Entomological Research.

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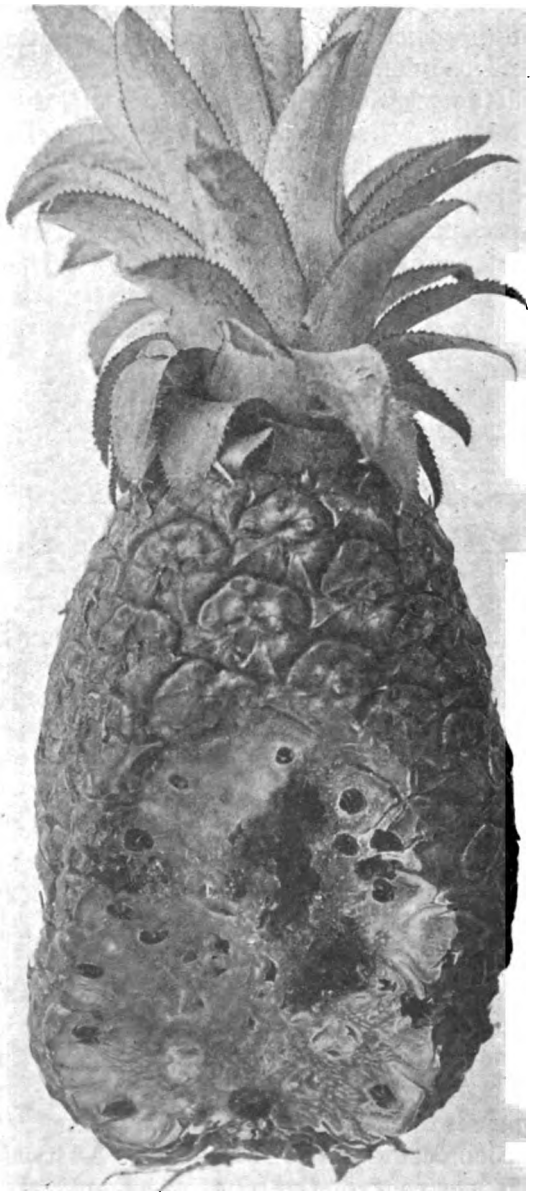

Plate XXIII.—Pineapple destroyed by the grubs of the pineapple black weevil. The holes made by the grubs are plainly visible. (From photo by Archibald H. Ritchie, Government Entomologist of Jamaica.)

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Government Entomologist of Jamaica, the writer has been furnished with an account of the damage done by this pest as well as with photographs showing pineapple plants and fruit injured by it.

The weevil is large and black and the female deposits her eggs on or in the leaves and stems of the plant. The larvæ, or grubs, hatching from these eggs tunnel through all parts of the plant both above and below ground. The grub is described as being legless (as are all weevil grubs), yellowish white and with a peculiar, prominent swelling or bump on the posterior third of the body. The attack upon the fruit is thus described by Mr. Ritchie*:

"Upon the pineapple just developing, initial attack is indicated by exudation of pinkish jelly which coagulates in beads or groups of beads.

"The opening of the burrows of the grub may be indicated by the voidance of pine frass of a yellow color.

"The attack may be at any point of the fruit, from the collar of the crown down to the junction of the fruit and stalk.

"The fruit before it is shot from the 'cabbage' may be attacked and hence never develop. This condition might be called 'dead-heart.'

"The fruit may be attacked just after being shot and the decaying brown shell of the fruit is all that remains."

With reference to the manner of attack on the plant itself, Mr. Ritchie's investigation shows that this may be:

"By way of the fruit stalk, the channel leading from the decaying fruit, first attacked, down into the pine proper.

"At the base of the leaf; the younger grubs appear to bore through the base of one or two leaves as indicated by tiny holes, but for the voidance of frass the grub later makes a bigger opening to the exterior and these openings, when the leaves are stripped off, are very conspicuous. The accumulation of frass and jelly down among the leaves is a clear indication of attack.

"The plant may be entered before the fruit is formed and a 'dead-heart' condition results.

"Once entered, the grub proceeds to tunnel out the entire plant and root system with the result that the plant is destroyed and dries out."

The above description is sufficient to show the destructive-

*Journal of the Jamaica Agr. Society, Vol. XX, No. 8, Aug., 1916, pp. 316-318.

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ness of the pest. The manner in which the pineapples are tunneled by the grubs is shown in Plate XXIII.

No treatment for infested plants has been discovered and as a means of preventing the spread of the pest to new areas the custom has been adopted in the affected district of Jamaica of digging out the infested plants and slashing the fruits open with cutlasses so that the grubs within them can be destroyed by birds, ants, lizards, etc.!

The grubs are readily transferred in pineapple slips. It is known that pineapple slips have been shipped from Jamaica to Cuba and from Cuba pineapple slips are shipped into Florida each season by the carload!

It is even possible that this pest has already reached the pineapple plantations of Florida and all growers of pineapples are urged, for their own protection and that of the industry, to keep a close lookout for indications of the "Black Weevil" in their fields and promptly report any suspicious findings to the Plant Board. The discovery of a destructive pest of this kind would of course be the occasion for an immediate effort at its eradication.

DEPARTMENT OF CITRUS CANKER ERADICATION

The following reports on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, have been compiled by Mr. Frank Stirling, General Inspector:

DECEMBER, 1916*

Citrus grove trees inspected	1,362,610
Citrus nursery trees inspected	5,756,225
Inspectors employed	363
New properties showing infection	4
Total properties showing active infection	12
Grove trees found infected	27
Nursery trees found infected	0
Counties in which active infections were found	3

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914**	13,336
Nursery trees found infected since May, 1914	342,221
Number properties infected to December 31, 1916	441
Properties declared no longer "danger centers"	291
Properties still classed as "infected", December 31, 1916	150

*The Plant Commissioner's Annual Report, which will appear in the April number of the Quarterly Bulletin, contains the history and data concerning infections up to December 1, 1916.

**The time at which eradication of citrus canker was commenced by the Florida Growers' and Shippers' League. Statistics as to the number of infected trees and properties prior to that time are not available.

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The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to December 31, 1916:

1914		1915		1916	
		January	306	January	86
		February	165	February	21
		March	444	March	49
		April	408	April	49
May	108	May	1042	May	338
June	160	June	772	June	450
July	275	July	651	July	349
August	1313	August	1345	August	219
September	767	September	618	September	124
October	565	October	214	October	451
November	773	November	494	November	131
December	366	December	256	December	27

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING DECEMBER 31, 1916*

The following report on the inspection of shipments and importations, at all stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

Ships and Vessels Inspected:		
From foreign ports		359
From U. S. Ports other than Florida		152
From Florida ports		188
Total		699
Shipments Inspected:		
Arriving by water:		
Passed	67	
Treated and passed	25	
Returned to shipper	30	
Contraband destroyed	196	318
Arriving by express or freight:		
Passed	364	
Treated and passed	84	
Returned to shipper	39	
Detained, subject to return by owner	21	
Contraband destroyed	53	561
Total shipments inspected		879

*The Plant Commissioners' Annual Report, which will appear in the April number, contains a summary of the work in this Department to September 30, 1916.

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Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of Shipments Infested
Whitefly	Avocado	Florida	2
Whitefly	Citrus	Florida	10
Whitefly	Guava	Florida	2
Whitefly	Jessamine	Florida	2
Whitefly	Privit	Georgia	1
Whitefly	Hibiscus	Florida	2
Whitefly	Coleus	Florida	1
Long scale	Citrus	Florida	3
Purple scale	Citrus	Florida	7
Florida red-scale	Citrus	Florida	1
Florida red-scale	Magnolia	Florida	1
Florida red-scale	Camphor	Florida	2
Chaff scale	Citrus	Florida	1
San Jose scale	Peach	Georgia	1
San Jose scale	Shrub	Georgia	1
San Jose scale	Rose	Georgia	1
San Jose scale	Apple	Georgia	1
San Jose scale	Cherry	Georgia	1
San Jose scale	Plum	Georgia	3
San Jose scale	Peach	Indiana	1
San Jose scale	Pear	Indiana	1
San Jose scale	Peach	Kentucky	1
San Jose scale	Peach	New Jersey	1
San Jose scale	Peach and plum	Missouri	1
Oyster-shell scale	Birch	Maine	1
Florida wax-scale	Citrus	Florida	1
Snow scale	Hibiscus	Florida	3
Snow scale	Shrub	Florida	1
Chrysomphalus sp.	Rose	Virginia	1
Cottony cushion-scale	Coleus	Florida	2
Mango scale	Mango	Florida	1
Dictyospermum scale	Palm	New Jersey	1
Dictyospermum scale	Palm	Pennsylvania	1
Dictyospermum scale	Citrus fruits	New York	2
Oleander scale	Citrus fruits	New York	2
Aspidiotus Britannicus	Laurel	Georgia	1
Soft brown scale	Laurel	Georgia	1
Soft brown scale	Hibiscus	Florida	3
Soft brown scale	Citrus	Florida	1
Putnam scale	Peach and plum	Missouri	1
Diaspis sp.	Peach and plum	Missouri	1
Birch scale	Birch	Maine	1
Fiorinia fioriniae	Camellia	Florida	1
Mealy-bug	Shrub	Cuba	1
Mealy-bug	Citrus fruits	New York	1
Papaya fruit-fly	Papaya	Florida	3
Bamboo borer	Bamboo	Louisiana	2
Peach tree borer	Peach	Missouri	1
Peach tree borer	Peach	Tennessee	1
Peach tree borer	Peach	Georgia	1
Root-knot	Pecan	Florida	1
Root-knot	Peach	Florida	2
Root-knot	Hibiscus	Florida	2
Root-knot	Fig	Florida	3
Root-knot	Vines	Florida	1
Root-knot	Fig	Georgia	3
Root-knot	Rose	Georgia	1
Root-knot	Grape	New York	1

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Insect or Disease	Occurring on	From	Number of Shipments Infested
Root-knot	Grape	Georgia	1
Root-knot	Peach	Georgia	3
Root-knot	Peach	Missouri	2
Root-knot	Shrubs	Georgia	2
Root-knot	Laurel	Georgia	1
Root-knot	Plum	Oklahoma	1
Root-knot	Peach	Oklahoma	1
Root-knot	Rose	West Virginia	1
Root-knot	Alamanda	Georgia	1
Root-knot	Alamanda	Florida	1
Crown gall	Rose	Florida	1
Crown gall	Rose	Georgia	2
Crown gall	Peach	Georgia	1
Crown gall	Pear	Missouri	1
Crown gall	Rose	Pennsylvania	1
Crown gall	Rose	Ohio	1
Crown gall	Peach	Oklahoma	1
Withertip	Citrus	Florida	1
Withertip	Citrus	Cuba	2

THE SWEET POTATO ROOT-BORER IN FLORIDA

WILMON NEWELL

Prof. J. R. Watson, Entomologist of the University of Florida Experiment Station, has issued a circular of warning regarding the sweet potato root-weevil, which has recently been found to occur in one of the northern as well as in two southern counties of the State. In many of the sections in other Gulf States, where this pest occurs it has rendered the successful production of sweet potatoes impossible. The sweet potato is perhaps the most important source of food for the poorer people of Florida and destruction of this crop, even in a majority of years, would cause deprivation to those for whom the securing of a livelihood is always difficult.

So serious does this menace to the potato crop appear that the Plant Board, at its meeting on January 8, 1917, authorized an immediate investigation by its Entomological Department to determine how widespread the pest has become in this State, how destructive it is likely to be under Florida conditions and the possibility of restricting its further spread by suitable quarantine measures.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner* ..... *Editor*

ASSOCIATE EDITORS.

E. W. BERGER ..... *Entomologist*
F. M. O'BYRNE ..... *Nursery Inspector*
R. A. JEHLE ..... *Asst. Plant Pathologist*
FRANK STIRLING ..... *General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

THE PRESENT ISSUE. Even though the first number of The Quarterly Bulletin was devoted entirely to citrus canker, and another article on the same subject appears in this issue, it is not our intention to let this subject monopolize our pages. However, to the citrus growers of the State the subject is a very important and serious matter and most of them doubtless feel that, for their own protection, they cannot know too much about the disease. It is hoped that the general discussion of the disease by Dr. Jehle in this issue, used in conjunction with the colored illustrations which were printed in the October issue, will give every grower a clear understanding of the nature of the disease, how it is spread and more particularly the measures which must be taken—by growers as well as officials—for preventing its spread and for facilitating its final eradication.

The Annual Report of the Plant Commissioner to the State Plant Board is now in press and, upon its completion, will be transmitted by the Board to His Excellency the Governor of Florida. In order that those vitally interested in the work of the Board in eradication and control of various pests and diseases may know what is being done along this line, the Board has directed that the Commissioner's Annual Report be published in the next (April) number of The Quarterly Bulletin.

The report will contain, among other things, a summary of

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the canker eradication work up to November 30, 1916, and of the Port and Railway Inspection work to September 30, 1916. The summaries of the work in these two departments, published in this issue, complete the reports on these departments to December 31, 1916. Future issues of The Quarterly Bulletin will contain reports for the respective quarters, or three-months periods.

THE UNKNOWN CANKER INFECTION. Few people realize the extent of the citrus areas of Florida and the magnitude of inspecting all citrus trees and properties for citrus canker. Everything possible has been done in the way of tracing suspected shipments of nursery stock and most of the centers of infection have been found in this way. Likewise, everything possible is being done to prevent spread of the disease from known centers of infection. The writer has estimated that it would require from three to five years for a force of 500 inspectors to make even one inspection of the citrus properties in Florida. Until this is done the growers cannot feel sure that all centers of infection have been located and the disease brought under control.

Against the undiscovered infection there can be but one safeguard: the application of such sanitary methods on the part of the individual growers that canker can *not* get into their properties, no matter from what source it may come. Laborers, ladders, farming implements, visitors, etc., are all possible carriers of the bacteria which cause citrus canker and if any undiscovered centers of infection do exist it is a certainty that people are daily passing from such centers to healthy properties.

The suggestion, made by the Plant Board a couple of months ago, that all citrus properties should be handled in a sanitary way, has been accepted with enthusiasm in nearly all the important sections. In many neighborhoods laborers are not employed until their persons and clothing are disinfected, ladders and field boxes are disinfected between properties and packing houses have installed dipping vats in which all field boxes are disinfected before they leave the packing house. In addition to such measures being a safeguard against the undiscovered center of canker infection, they tend to prevent the spread of many other diseases, such as scaly bark. A circular fully describing these measures has been prepared and will be sent free on application to the Plant Commissioner.

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Vol. I APRIL, 1917 No. 3

THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by

STATE PLANT BOARD OF FLORIDA

GAINESVILLE, FLA.

Entered as second-class matter November 11, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

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STATE PLANT BOARD
Of Florida

P. K. YONGE, *Chairman* ..... Pensacola
E. L. WARTMANN ..... Citra
T. B. KING ..... Arcadia
W. D. FINLAYSON ..... Old Town
F. E. JENNINGS ..... Jacksonville
J. G. KELLUM, *Secretary* ..... Tallahassee

Staff

WILMON NEWELL, *Plant Commissioner* ..... Gainesville
E. W. BERGER, *Entomologist* ..... Gainesville
F. M. O'BYRNE, *Nursery Inspector* ..... Gainesville
R. A. JEHLE, *Asst. Plant Pathologist* ..... Homestead
FRANK STIRLING, *General Inspector* ..... Gainesville

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. 1 APRIL, 1917 No. 3

REPORT OF THE STATE PLANT BOARD FOR THE FISCAL YEAR ENDING APRIL 30, 1916 AND SUPPLEMENTAL REPORTS

LETTER OF TRANSMITTAL

January 2nd, 1917.

To His Excellency,
Sidney J. Catts,
Governor of Florida.

SIR: Herewith is submitted the report of the State Plant Board for the year ending April 30th, 1916, and supplemental report to August 31st, 1916. We request that you submit same to the Legislature.

Respectfully,
STATE PLANT BOARD,
By P. K. YONGE,
Chairman.

REPORT OF STATE PLANT BOARD

The report of the Plant Commissioner, Wilmon Newell, which is hereto attached and to which we invite your careful attention, covers so completely the work of the Plant Board that we deem it unnecessary to refer to any part of it specifically, except as to the matter of appropriations.

GENERAL WORK

We have given very careful consideration to this subject and we are of the opinion that the amount estimated by the Commissioner as necessary for the general work of the Board is not sufficient. The scope of the work contemplated by the Plant Act is very broad and the necessity for developing the work, especially the Department of Nursery Inspection and the De-

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partment of Port and Railway Inspection, is urgent. We think that $85,000.00 per annum will be necessary for this work. The additional amount over that suggested by the Plant Commissioner is for salaries and traveling expenses of the heads of departments and for printing. As there is a continuing appropriation of $35,000.00 for this work, we recommend that an additional appropriation of $50,000.00 per annum for the next biennium be made.

Citrus Canker Eradication

Citrus Canker is one of the most destructive plant diseases known and is far the most serious menace to the Citrus Industry of Florida that we have encountered. The disease destroys the tree it attacks and is easily carried from the infected tree to other trees. It is very difficult to eradicate for the following reasons:

(1) The difficulty of detecting it in its early stages.

(2) A person, bird, insect or any other thing coming in contact with the infection may disseminate it.

(3) It may lay dormant months, sometimes about two years, before being discovered.

For these reasons a strict and long quarantine and frequent inspections are necessary. Notwithstanding the seriousness of the disease and the difficulty of its eradication much has been accomplished towards this end and we believe it can be completely eradicated. In the light of our experience in this work and from present indications we think it will take from two to three years to eradicate it. In arriving at a conclusion as to the probable cost we must carefully consider present conditions and also the danger of further outbreaks of the disease. The Plant Commissioner bases his opinion of what will be required for the next two years on our experience and the cost for the five months ending September 30th, 1916, and this method appears to us to be a reasonable one. The amount expended during this period was $179,671.51 and on this basis $431,211.50 per annum would be necessary. No doubt you will give the subject most careful consideration and we hope you will find it expedient to make the necessary appropriation to continue the work of eradication to a successful conclusion.

State Plant Board,
By P. K. Yonge,
Chairman.

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REPORT OF THE PLANT COMMISSIONER

Hon. P. K. Yonge, Chairman,
State Plant Board of Florida.

SIR: I have the honor to submit herewith my report on the work of the State Plant Board for the fiscal year ending April 30, 1916, and supplemental reports.

Respectfully,
WILMON NEWELL,
Plant Commissioner.

ORGANIZATION OF THE BOARD

The State Plant Board was created by an Act of the Legislature approved April 30, 1915, this Act being Chapter 6885 of the Laws of Florida, and known by the short title of "The Florida Plant Act of 1915". The Act provided that the State Plant Board should consist of five members, being the same persons who constitute the Board of Control.

The first meeting of the Board was held at Jacksonville on May 4, 1915, and Mr. P. K. Yonge elected Chairman of the Board. At this meeting it was decided that the place of the chief executive officer should be filled temporarily by a special committee, known as the "Advisory Committee", consisting of Mr. P. H. Rolfs, Director of the Florida Experiment Station; Mr. L. S. Tenny, Secretary-Manager of the Florida Growers' and Shippers' League, and Mr. W. J. Krome, of Homestead, Florida. The Advisory Committee was authorized to execute all orders of the Board and to carry out its rules and regulations. As an emergency existed at this time, due to the occurrence of citrus canker in certain parts of the State, rules were adopted by the Board, under the provisions of the Plant Act, looking to the eradication of the disease and to prevention of its further spread.

At the following meeting of the Board, held May 10, 1915, it was decided that the chief executive officer of the Board should be known as the "Plant Commissioner" and that the work of the Board should be divided into four departments, namely, the Departments of Citrus Canker Eradication, Nursery Inspection, Plant Pathology and Entomology. A fifth department, that of

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Port and Railway Inspection, was subsequently provided for. This division of the work has been found thoroughly practical and under this plan has gone steadily forward. The work of the respective departments is mentioned on subsequent pages.

ADVISORY COMMITTEE

From May 4, 1915, until August 14, 1916, when they resigned, the members of the Advisory Committee, serving without remuneration, gave unstintingly of their time and efforts in forwarding the work of the Board. Mr. Krome assumed full charge of the canker eradication work in Dade County, Mr. Tenny supervised the eradication work in the remainder of the State and Mr. Rolfs supervised the work of nursery inspection.

A Plant Commissioner was elected by the Board at its meeting on July 12 and commenced his duties on August 24, 1915. Owing to the magnitude of the work confronting the Board the members of the Committee continued to serve, acting in an advisory capacity to both the Board and the Plant Commissioner. The thanks of the entire State are due these gentlemen for their services, so efficiently rendered, at a time when the State's principal fruit industry was threatened by citrus canker, the most destructive plant disease ever known in the history of horticulture.

RULES AND REGULATIONS

In accordance with the provisions of the Plant Act the Board has from time to time adopted and published rules and regulations for preventing the introduction of dangerous insect pests and plant diseases into the State, for preventing the further dissemination of such as already occurred within the State and for eradicating certain plant diseases of extremely dangerous nature. These rules were published, as adopted, in the Circulars of the Board.

April 30, 1915, to April 30, 1916

Circulars Nos. 1 to 9, inclusive, were published between May 1, 1915, and February, 1916. Circular No. 10, issued March 23, 1916, contained all rules adopted by the Board up to that time, and Circular No. 11 contained additional regulations of the Board adopted at its April meeting.

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May 1, 1916, to October 31, 1916

During this period Circulars 12 to 16, inclusive, containing rules and regulations adopted at the May, June, July, August, September and October meetings of the Board, were issued. In addition, Circular No. 17, issued October 31st, contained an Order issued by the Third Assistant Postmaster General on October 24, 1916, providing for the inspection, by the Plant Board, of mail shipments of plants and plant products arriving at Florida post offices.

Circulars 10 to 17, inclusive, contain all rules, regulations and public notices of the Board in effect October 31, 1916.

OFFICES AND LABORATORIES

The Plant Act provides that the offices of the Plant Board shall be located at the University of Florida at Gainesville. Through the courtesy of the University officials, rooms were assigned to the Plant Board on the second floor of Language Hall and these were occupied in September of 1915. At the present time four rooms are occupied by the Plant Commissioner, his assistants, stenographers and clerks, one room by the Nursery Inspection Department and one by the Department of Entomology. In addition to these, storerooms and an entomological laboratory have been established in the attic of Language Hall and a special room for the inspection of plant shipments, with facilities for fumigation, disinfection, etc., has been equipped in the basement of the same building.

Even these facilities are very inadequate for handling the executive work incident to the Board's working staff of upwards of four hundred employees, correspondence with nurserymen, fruit growers and farmers of the State and the laboratory investigation which is a necessary part of the eradication and control work being conducted in connection with many pests and diseases in various parts of the State.

TROPICAL LABORATORY

The necessity for scientific studies of citrus canker as a means of perfecting methods for facilitating its eradication, and for the further purpose of finding, if possible, a remedy for the

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disease, was recognized by the Board immediately upon its organization.

The establishment of a special laboratory for these investigations was made possible by the generosity and public spirit of the South Dade County Fruit Growers' and Truckers' Association. The Association erected at Redland, Dade County, a capacious building to be used jointly as an auditorium and laboratory. Practically one-half of this building was turned over to the Plant Board for laboratory work, the only expense to the Board being the equipment of the laboratory with the necessary apparatus. Dr. R. A. Jehle was elected Assistant Plant Pathologist to the Board on July 12, 1915, and, pending completion and equipment of the laboratory, he devoted his time to field investigations of citrus canker. The laboratory was formally opened November 27, 1915. Investigations have been steadily pursued since that time under Dr. Jehle's supervision. Some valuable results have thus far been obtained, to which reference is made on a subsequent page under the heading of "Department of Plant Pathology".

ERADICATION OF CITRUS CANKER

The first case of citrus canker found in Florida was discovered in Jefferson County on September 30, 1912, by the Inspector of Nursery Stock, Dr. E. W. Berger. At that time the disease was new and totally unknown. Specimens collected by Dr. Berger at Monticello on September 30, 1912, were subsequently found to be identical with the disease which later came to be known as "citrus canker". In July of 1913, the same disease was found in a nursery in Dade County and though every effort was made by the Inspector of Nursery Stock, under existing laws and with the limited resources at his command, to prevent its spread, the disease appeared in some of the citrus groves in that County in the spring of 1914.

The sudden appearance of a new and destructive disease was unprecedented. Dr. Berger's keen realization of the possibilities this disease possessed for creating havoc to the citrus industry and his activity in calling attention of the growers to it was largely responsible for the prompt measures taken to suppress it. Had as much as two more years passed without adequate legislation and appropriations for fighting the disease, citrus canker would without doubt have secured such a wide distribution in the State as to have made the cost of era-

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dication run into the millions of dollars, if indeed it would not have been rendered impossible.

In May of 1914 the Florida Growers' and Shippers' League, realizing the gravity of the situation, contributed funds for a preliminary investigation of the trouble and Mr. L. S. Tenny, Secretary-Manager of the League, assumed personal charge of the work. Mr. Frank Stirling was employed at the expense of the League to make a survey under direction of the Inspector of Nursery Stock to determine the extent to which the disease had spread. By June of 1914 the growers of Dade County realized that a disease of extremely virulent nature had appeared in many of their groves. Additional funds were appropropriated by the Growers' and Shippers' League and additional inspectors were employed to wage warfare on the disease. Attempts to control the disease by means of sprays and by cutting out infected leaves, twigs and branches and treating the remaining portions of the trees with disinfectants proved ineffective. In July, 1914, the growers abandoned hope of curing infected trees and adopted a campaign of eradication consisting of the destruction of the infected trees by fire.

Additional contributions were made by the growers of Dade County, these aggregating in the neighborhood of $30,000 up to the time of passage of the Plant Act in April, 1915. The Florida Growers' and Shippers' League expended $17,770.58; citrus growers in other sections of the State, transportation companies, marketing agencies, etc., contributed approximately $30,000 more, and His Excellency, Governor Park Trammell, contributed $1000 out of his contingent fund.

During the summer of 1914, the same disease, though its identity was unknown, was found to be destroying citrus plantings on Santa Rosa Peninsula in Walton County. Here too, the growers tried various remedial measures to no avail and, without any knowledge of what was transpiring at the same time in Dade County, employed Mr. Harold Mowry as inspector for their Association and adopted the plan of destroying by fire all infected trees discovered.

By the end of 1914 the disease had also been found in Broward, Brevard, Escambia, Lee, Palm Beach, Pasco and Pinellas Counties, apparently in restricted areas.

The United States Department of Agriculture was constantly in touch with the situation in Florida and other Gulf States, and as a result of information furnished to Congress by the

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Honorable Secretary of Agriculture that body made an appropriation of $35,000, available February 1, 1915, for the purpose of investigating the possibility of eradicating the disease. Of this sum, $24,254.53 was expended by the Bureau of Plant Industry in Florida and the remainder in the other Gulf States.

The seriousness of this menace to the citrus industry of Florida was generally recognized throughout the State when the Legislature convened in the spring of 1915 and the necessity of adequate legislation for dealing with the existing emergency, as well as the self-evident need for protection of the agricultural and horticultural industries of the State against the introduction of additional destructive pests and diseases, was largely responsible for the passage of the Florida Plant Act. This Act was approved April 30, 1915, and in addition to creating a State Plant Board and providing the legal facilities for dealing with such situations, made available a continuing appropriation of $35,000 per annum for the work of the State Plant Board and a special fund of $125,000 for the eradication of citrus canker.

April 30, 1915, to April 30, 1916

Within four days after the approval of the Plant Act the Plant Board organized and assumed charge of the canker eradication work throughout the State, as well as of the nursery inspection work.

The Bureau of Plant Industry, United States Department of Agriculture, co-operated in the canker eradication work until June 30, 1915, at which time the Congressional appropriation of $35,000 became exhausted, the official expense of the work being borne jointly by the Bureau and the State Plant Board from May 1, 1915, to June 30, 1915.

The Florida Growers' and Shippers' League continued to take an active part in the eradication work during 1915 and, subsequent to the passage of the Plant Act, expended $7,249.04 in this work.

From July 1, 1915, until February 29, 1916, the State Plant Board conducted the eradication work without assistance from the Federal Government, defraying the expense thereof out of the appropriations made by the Legislature in connection with the passage of the Plant Act.

At a mass meeting of citrus growers held at Gainesville, Florida, October 6, 1915, a committee, consisting of Messrs.

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D. C. Gillett (Chairman), L. B. Skinner, J. H. Ross, L. D. Jones, and Geo. S. McClure, was appointed and instructed to place before Congress the need of Federal aid in dealing with this disease. Similar committees, appointed from Texas, Louisiana, Mississippi and Alabama, in which States the disease was now known to occur, co-operated with the Committee from Florida in placing before Congress the seriousness of the situation.

Although the disease had not appeared in California or Arizona, the citrus growers and members of Congress realized the importance of eradicating it and co-operated with the committees from the Gulf States in presenting the matter to Congress. As a result of these representations and through the endorsement of the Honorable Secretary of Agriculture, David F. Houston, an appropriation of $300,000 for canker eradication in the United States was included in the Urgent Deficiency Bill approved February 28, 1916. Immediately upon this fund being made available the Bureau of Plant Industry resumed active co-operation with officials of the States in which canker occurred, Florida included. An additional sum of $250,000 was included by Congress in the Agricultural Bill, approved August 11, 1916.

Up to the end of February, 1916, there had been expended out of the Plant Act Special Fund $108,415.36. During March and April, 1916, the greater part of the expense of this work in Florida was defrayed by the Bureau of Plant Industry out of the Federal appropriation mentioned. During these two months $32,751.13 was expended in the eradication work. Of this sum, $576.69 was defrayed out of the Plant Act Special Fund and $32,174.44 out of the Federal appropriation.

The following schedule shows the disbursements, by months, out of the Plant Act Special Fund during the fiscal year:

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Month	Salaries	Traveling Expenses	Supplies	Total for Month
May, 1915	$ 2,269.74	$ 464.02	$ 553.36	$ 3,287.12
June, 1915	3,496.71	983.64	868.91	5,349.26
July, 1915	11,437.69	1,299.73	810.73	13,548.15
August, 1915	12,563.32	1,188.26	535.10	14,286.68
September, 1915	12,623.54	1,911.26	902.61	15,437.41
October, 1915	11,061.97	2,417.09	1,018.61	14,497.67
November, 1915	10,506.15	1,837.36	939.74	13,283.25
December, 1915	7,597.50	1,812.16	132.75	9,542.41
January, 1916	7,698.18	1,685.35	346.76	9,730.29
February, 1916	7,635.33	1,588.77	229.02	9,453.12
March, 1916	30.00	135.13	215.33	380.46
April, 1916	144.15	41.62	10.46	196.23
Total for fiscal year				$108.992.05

May 1, 1916, to September 30, 1916

During this period the cost of the canker eradication work in Florida was $179,671.51, of which sum $2,484.22 was defrayed out of the Plant Act Special Fund and $177,187.29 by the Bureau of Plant Industry out of the Federal appropriations.

It appears that, up to September 30, 1916, a total of at least $432,462.44 was expended in the eradication of citrus canker in Florida, the sources of this amount having been as follows:

Through the Inspector of Nursery Stock, prior to April 30, 1915, estimated*	$ 1,350.29
Contributions by growers and citizens of Dade County, 1914-1915, estimated	30,000.00
By Florida Growers' and Shippers' League, prior to April 30, 1915	17,770.58
By Florida Growers' and Shippers' League, subsequent to April 30, 1915	7,249.04
Contributions by citrus growers of Florida (exclusive of Dade County), transportation companies, marketing agencies, etc., estimated	30,000.00
Out of Governor's Contingent Fund, 1914-1915	1,000.00
First Federal appropriation, February to June, 1915	24,254.53
Plant Act Special Fund, April 30, 1915, to February 29, 1916	108,415.36
Plant Act Special Fund, March 1, 1916, to April 30, 1916	576.69
Plant Act Special Fund, May 1, 1916, to September 30, 1916	2,484.22
Federal appropriation, through Bureau of Plant Industry, March 1, to April 30, 1916	32,174.44
Federal appropriation, through Bureau of Plant Industry, May 1, to September 30, 1916	177,187.29
Total to September 30, 1916	$432,462.44

*In connection with the general work of inspecting and quarantining nurseries.

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Training of Inspectors

The necessity for employing only trained inspectors in the campaign against citrus canker was self-evident from the time the disease was first discovered in Dade County. The inspection methods were largely developed by the growers of Dade County during 1914 when they were carrying on the work at their own expense and the growers themselves were serving as volunteer inspectors.

The readiness with which the disease was transmitted from one citrus tree to another resulted in a practice of disinfecting the hands by all parties who examined the infected trees. This was followed shortly by disinfection of the workmen's clothing by spraying it with a disinfecting solution. Following this it was decided that still greater safety would be secured by wearing a union overall suit and removing this entire suit and disinfecting it whenever the grower left a canker-infected property. The use of the overall suit shortly led to the development of a one-piece inspection suit made of white cloth to cover the entire clothing of the inspector. This suit, worn with leggings, shoes and a special hat, all of which, together with the hands, arms and faces of the inspectors, are disinfected when they leave properties under inspection, has become the standard inspection outfit worn by all inspectors.

The men engaged in the eradication work in Dade County in 1914 obtained a knowledge of citrus canker and the methods of detecting it by actual experience, and these men became the nucleus of the inspection force employed by the Growers' and Shippers' League in 1914.

With the creation of the Plant Board, April 30, 1915, the inspection force which had been previously employed by the Florida Growers' and Shippers' League was taken over in its entirety. During the summer of 1915 additional inspectors were acquired and were, in all cases, trained by serving apprenticeships in the canker-infected properties under the tutorage of men who had previously been thoroughly trained. These apprenticeships were, in all cases, served by the prospective inspector at his own expense and the completion of a satisfactory apprenticeship was a necessary prerequisite to his appointment as an inspector. With the extension of the canker eradication work into new territory and the imperative need of additional inspectors in the spring of 1916, it was seen that there were not sufficient facilities for training by the apprenticeship method

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the large number of inspectors that would be required. Accordingly, a so-called "citrus canker school" was established at Gainesville. Applicants whose previous training, experience, and moral character indicated that they possessed the qualifications necessary to the making of competent inspectors were admitted to the two-weeks classes of instruction at their own expense.

The first of these classes commenced on March 3rd and was concluded on March 14th, 1916, twelve inspectors being trained. A second class held from March 16th to April 1st, 1916, trained 13 inspectors. The third class, April 3rd to 15th, trained 12; the fourth class, May 1st to 13th, trained 36 inspectors; and the fifth class, June 6th to 17th, trained 65 inspectors, making a total of 138 inspectors specially trained in these classes.

The course of training given these men consisted of lectures covering all phases of citrus canker eradication work; the methods of disinfecting employed under various conditions and circumstances; the Florida Plant Act of 1915 and the rules and regulations of the Plant Board relative to the work of inspectors and quarantines; methods of differentiating citrus canker from other diseases of citrus plants; the relation between the Federal Department of Agriculture and the State organization in conducting the canker eradication work and numerous other subjects vitally connected with the work of canker eradication. The lectures were supplemented by actual field practice in the inspection of citrus properties in the vicinity of Gainesville. Each prospective inspector was required to pass an eyesight test, as well as an examination at the end of his training course.

It was only by means of these classes of instruction that it was possible to secure as many trained inspectors as were imperatively needed for the canker eradication work.

It is a pleasure to report that the men trained in these classes have shown themselves as proficient as those who were trained as apprentices in the field. While there is perhaps little choice between the two methods of training, the greatest efficiency would be attained if all inspectors were enabled to take the course of training in addition to a field apprenticeship.

Field Organization

In sections where a considerable number of inspectors are employed the inspectors work in squads of four in charge of an experienced foreman. The foreman is directly responsible to

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the District Inspector, who may have charge of from five to fifteen squads. The territory assigned to each District Inspector is dependent upon conditions and the extent of infected properties with which he has to deal. In some cases a district consists of less than a county and in other cases it consists of from two to three counties. The District Inspectors are directly responsible to the Plant Commissioner. Only the most experienced and tried men are assigned to detached duty.

In addition to the inspection force a limited number of employees are designated as Grove Supervisors. The principal duty of the Grove Supervisor is to secure the co-operation of the owners of canker-infected properties in so conducting the work in their properties that danger of spreading the disease will be reduced to a minimum. In all cases, the men selected for the position of Grove Supervisor are experienced citrus growers who have received adequate training on the canker inspection forces.

Locating the Centers of Infection

The introduction of citrus canker into Florida, as well as its dissemination from one locality to another within the State, had been through the medium of nursery stock shipments from infected nurseries.

One of the first problems confronting the Plant Board was to find out what nurseries were, or had been, infected, to what points these nurseries had shipped citrus trees and whether these trees had developed the infection after reaching the growers who received and planted them. It had been determined by the former Inspector of Nursery Stock, Dr. E. W. Berger, that four citrus nurseries within the State were infected and that these nurseries had made shipments prior to the discovery of canker in them. It was also found that an infected nursery in another State had made citrus shipments into Florida. From the nurseries themselves, from transportation companies and from all possible sources, lists were obtained of these shipments. It was found that a total of 3,131 shipments of "dangerous" citrus nursery stock, comprising a total of 338,512 trees, had been distributed in Florida by these nurseries. These shipments had gone to 427 towns or villages in 51 counties of the State. When one considers that many shipments were to dealers or agents who re-distributed the trees in small lots, that growers frequently divided shipments with their friends or

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neighbors and that winter visitors to the State frequently ordered trees and presented them to relatives or friends, the magnitude of the task involved in finding and inspecting these 338,512 trees can be appreciated. The task did not stop with finding the trees and giving them one inspection, for, having been exposed to the danger of infection, they were likely to be carrying the disease in dormant form and might not develop it in visible form until many months afterwards. It was therefore considered necessary to make repeated inspections of these trees for from one to three years after they were planted before being assured of their safety. Several months of work and heavy expense were involved in finding these trees and *all* of them have not yet been found. However, the first inspection of those which could be located brought to light 62 centers of infection distributed through 21 counties. Fifty-six, or 90 per cent, of these infections were found on shipments made by one nursery firm.

In this connection it should be remembered that all of these shipments were made prior to the passage of the Plant Act. No case of distribution of canker on shipments of citrus trees made since the passage of the Plant Act has yet come to light. In other words, the quarantines imposed by the Plant Board in conjunction with infected properties seem to have effectually closed this avenue of dissemination.

When the dangerous nature of these "exposed" trees was fully realized through the finding of canker on an average of one tree out of every one hundred and eight of them, it became self-evident that the interests of both grower and State would best be served by their destruction, without waiting for the disease to manifest itself. However, the Plant Act authorized the forcible destruction of only such trees as actually showed infection. No matter how complete the evidence that a tree had been infected and would presently develop the disease it could not legally be destroyed until it showed the canker lesions or until its owner gave consent for its destruction.

An active campaign of education was accordingly launched by means of which the owners of these trees were apprised of their dangerous nature and their permission solicited for the destruction of them. In this work, growers' associations, boards of trade and individual growers of prominence gave their time and efforts freely. The cost which either the State or the Government would incur by continuing the inspection of these trees

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for from one to four years' time, before they could be considered as safe, was an added argument for their destruction.

Up to April 30, 1916, 146,753 of these dangerous trees (including the ones which showed infection) were destroyed with the owners' consent. Between May 1 and November 30, 1916, consent was secured for the destruction of 31,360 more, making a total of 178,113, out of the total of 338,512, destroyed up to November 30, 1916. There are, accordingly, 160,399 of these trees, the location of which is known, which must still be considered as dangerous and the periodical inspection of which must be continued for at least a year longer, unless the owners will in the meantime consent to their destruction.

Quarantines in and Around Infected Properties

It was early recognized that some form of quarantine would be necessary to prevent the spread of canker from infected properties and as all primary infections had been found due to shipments and movements of citrus trees which had been exposd to infection, the plan of preventing the movement of nursery stock from areas in which the disease occurred naturally suggested itself. Prior to the passage of the Plant Act, the Inspector of Nursery Stock had withheld inspection certificates from all nurseries located in localities where the disease was known to occur, thus establishing what was virtually a local or "district" quarantine.

At a conference of grove owners and members of the Board at Redland, Dade County, on June 18, 1915, a plan of quarantining was arrived at which gave promise of preventing dissemination of the disease without the hardships attendant upon quarantines applying to specified counties or districts considerable areas of which were apparently free from the disease. At this time the Board adopted its Rule 5, which declared every property infected with citrus canker to be the center of an infected and dangerous zone, this zone extending a mile in every direction from the boundaries of the infected property and within which center and zone all citrus trees and plants were declared to be plants likely to carry and disseminate citrus canker. The planting or movement of citrus trees and citrus budwood within such zone was prohibited. Upon the adoption of this rule local quarantines which had previously been imposed were repealed.

Rule 5 prevented the movement and distribution of nursery

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stock which was located in dangerous proximity to canker infections, prevented the distribution of canker from one point to another within the quarantined area on citrus trees and facilitated eradication by prohibiting the planting of any additional host plants, namely, citrus trees, within the dangerous area. Rule 5 effectually eliminated what had been, up to that time, the greatest factor in distributing the disease, namely, the movement of citrus trees which were actually infected but on which, in the majority of instances, the disease had not developed to the point of being visible.

As the eradication work progressed it became evident that the quarantine in the area extending one mile in every direction from an infected property could be modified when danger of further outbreaks within that area had apparently ceased. Owing to the length of time which canker could remain dormant it was self-evident that the infected property would have to be kept under inspection and close observation for several months before the quarantine surrounding it could be lifted. The condition of the trees in the property as to vigor and growth and the manner in which the property had been handled by the owner were also found to be important factors bearing on the probability of further outbreaks of the disease.

No quarantines of this character were raised by the Board until its meeting on October 11, 1915. At this meeting careful consideration was given by the Board to the records and history of infected properties which had shown no canker infections for periods varying from ten to sixteen months and in the case of properties wherein the Board felt assured no further cases of the disease would appear the quarantine was raised in so far as it affected the surrounding properties to a distance of one mile. As the ability of the canker bacteria to persist and multiply in the soil had by this time been established, the Board, when lifting these quarantines, specified that there should be no further planting of citrus in the infected properties until permission therefor had been granted by the Board.* In other words, the Board, when raising the quarantine surrounding an infected property, did not declare that the disease had been completely eradicated therefrom, but merely expressed the opinion that the property was no longer a "danger center" from which outbreaks of canker were likely to occur.

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*Up to the time of printing this report such permission has not been granted by the Board in any case.

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Distribution of the Disease in Florida

April 30, 1915, to April 30, 1916

At the time the Plant Act was approved, April 30, 1915, citrus canker was known to occur in the counties of Brevard, Broward, Dade, Escambia, Jefferson, Lee, Palm Beach, Pasco, Pinellas and Walton.

With the active inauguration of the Plant Board work infections previously existent were rapidly brought to light. During May of 1915, the disease was found in DeSoto and Santa Rosa Counties, during June in Baker County, during July in St. Lucie County, during August in Marion County, during September in Hillsboro and Seminole Counties, during October in Bay County and during December in Duval County. During January canker was found in Suwannee County, but during the months of February, March and April, 1916, infections were not found in any additional counties.

In some of the counties mentioned only one infected property was found, while in others the infected areas were more extensive and of a very serious nature. All of these infected centers were found as a result of systematically running down and inspecting citrus nursery stock shipments which had been made from canker-infected nurseries prior to the passage of the Plant Act. Approximately ninety per cent of the primary infections* were traced to shipments made by one nursery firm.

While the number of counties in which the disease had been found was relatively large, an adequate idea as to the extent of the infections can be had only by considering the number of individual properties in which the infection was found. The number of properties, in the entire State, known to be infected on April 30, 1915, was 243.

The number of additional infected properties discovered, as well as the number of infected properties declared by the Board to be no longer "danger centers", during the fiscal year, is shown below:

*By "primary infection" is meant the first infection of canker occurring in a locality. All primary infections of canker thus far found in the State were due to shipments of nursery stock from infected nurseries.

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Month	Number of properties found infected*	Number infected properties declared no longer "danger centers"
May, 1915	11	....
June, 1915	17	....
July, 1915	28	....
August, 1915	33	....
September, 1915	17	....
October, 1915	9	89
November, 1915	6	1
December, 1915	7	5
January, 1916	3	....
February, 1916	0	....
March, 1916	7	2
April, 1916	1	....
Totals	139	97

Summary, April 30, 1916

Properties infected April 30, 1915	243
Found infected between April 30, 1915, and April 30, 1916	139
Total properties infected to April 30, 1916	382
Declared no longer "danger centers"	97
Properties still classed as infected on April 30, 1916	285

May 1, 1916, to November 30, 1916

During the months of May, June, July, August and September no infections were found in counties not previously infected. During October an infection of long standing was discovered in Lake County. This infection was traced to two shipments of citrus nursery stock from an Alabama nursery in the spring of 1913* which had, fortunately, been planted in adjoining properties. The number of properties found infected for the first time and the number declared no longer "danger centers" during this period are shown below:

Month	Number of properties found infected	Number infected properties declared no longer "danger centers"
May, 1916	10	....
June, 1916	9	....
July, 1916	9	18
August, 1916	9	2
September, 1916	7	1
October, 1916	11	163
November, 1916	5	6
Totals	60	190

*Namely, properties not previously known to be infected.
*The exact date of one of these shipments cannot be determined. It may have been made in 1912.

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Grand Summary, November 30, 1916

Properties infected to April 30, 1916	382	
Additional properties found infected between May 1, and November 30, 1916	60	
Total properties infected to November 30, 1916		442
Properties declared no longer danger centers to April 30, 1916	97	
Declared no longer danger centers between May 1, and November 30, 1916	190	
Total	287	
Less properties showing subsequent infection	5*	
No longer danger centers, November 30, 1916		282
Properties still classed as infected on November 30, 1916		160

The following statement shows the total number of citrus trees, both infected and exposed to infection, which have been destroyed in the course of the canker eradication work up to the present time. Trees which had been exposed to the infection, but which had not shown visible canker, were in all cases destroyed by the owners or with their permission. The number of nursery trees given includes seedlings and plants in seed beds.

	Infected Trees Destroyed		"Exposed" Trees Destroyed	
Period	Grove Trees	Nursery Trees	Grove Trees	Nursery Trees
Prior to April 30, 1915	5,650	320,406	16,327	354,200
Apr. 30, 1915, to Apr. 30, 1916	5,597	21,364	42,910	2,185,634
May 1, 1916, to Nov. 30, 1916	1,931	448	33,399	6,780
Total	13,178	342,218	92,636	2,546,614

It is significant that the number of infected trees during the above periods steadily decreased.

The progress made in eradication of the disease is also indicated by a comparison of the number of infected properties on April 30, 1915, and on April 30 and November 30, 1916. On April 30, 1915, when the Plant Board came into existence, 243 infected properties were known, and many other infections were in existence but were as yet undiscovered. Despite the discovery of 139 additional infected properties during the following twelve months the number "infected" at the end of the fiscal

*In three of the properties declared no longer danger centers, in which canker infection subsequently appeared, circumstances indicated infection from outside sources; in the remaining two re-infection was undoubtedly due to hold-over dormant infections or to soil infections in the properties themselves.

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year, April 30, 1916, was but 285. From May 1 to November 30, 1916, the number of properties declared to be no longer danger centers was nearly four times as great as the number of newly infected properties found during the same period and on the latter date the number of "infected" properties was but 160. Stated in another way, eradication of the disease is believed to be complete in 282, or 63½ per cent of the total 442 properties in which canker has been found up to the present time.

The progress in eradication is also indicated by Figure 1, which shows the number of infected trees found in the State each month from May, 1914, to date. Several factors have operated to determine the number of infected trees found each month. For example, the periods of growth which the citrus trees usually undergo in midsummer and again in November are favorable to a rapid spread of the disease. A reduction in the number of inspectors employed has always been followed by an increase in the number of infections. On the other hand, the number of infections found during the periods of dormancy are lower than during periods of growth and an increase in the inspection force has always been followed by a decrease in the number of infections, even in the midst of the growing periods.

Figure 2 shows the number of canker-infected properties found in the State up to the end of any given month: likewise the number of infected properties declared no longer danger centers up to the corresponding date.

The preceding data, though greatly condensed, is sufficiently convincing to justify the conclusion that the continuation of the present campaign against citrus canker in Florida must inevitably result in its eradication from the State. Final eradication is assured if sufficient funds are constantly available so that the work may continue without interruption, under efficient management and with such energy and speed as to prevent any material spread of the disease while, at the same time, the remaining infections are being stamped out.

Legal Actions

On account of the active co-operation of the citrus growers and because of the practically universal support which the Plant Board has received in its efforts to enforce the quarantine measures necessary to the eradication of the disease, there has been but little occasion for resort to the courts.

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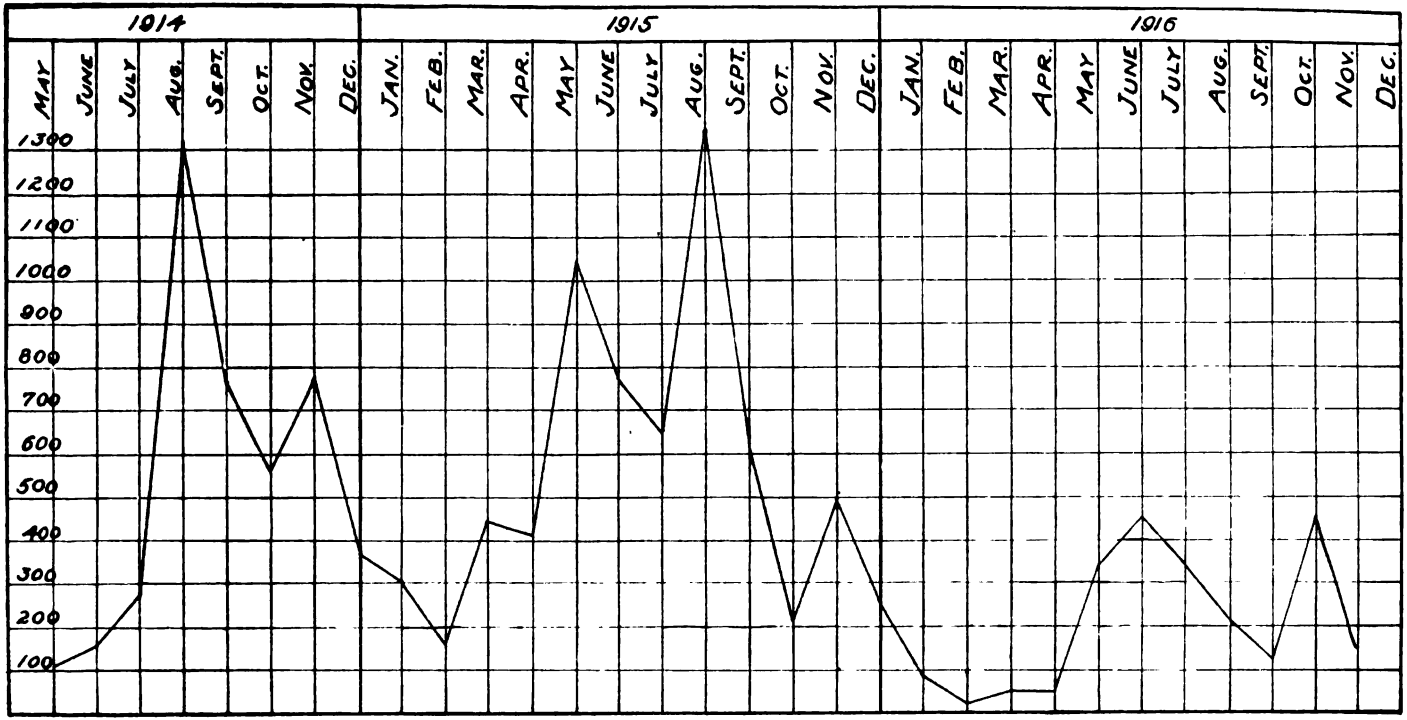

Fig. 1. Diagram showing the number of canker-infected grove trees found in Florida each month from May 15, 1914 (when eradication work was begun by the Florida Growers' and Shippers' League) to November 30, 1916.

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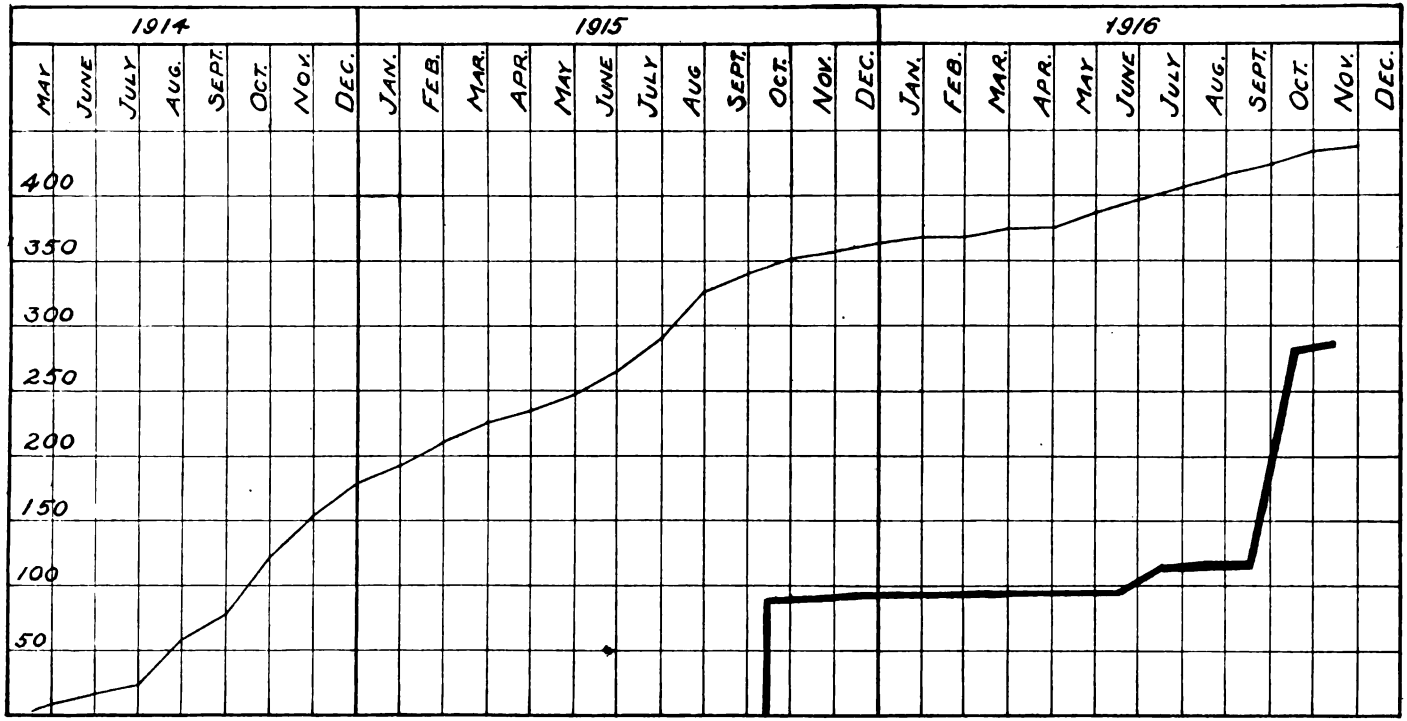

Fig. 2. Comparison of infected properties and properties declared no longer danger centers in Florida at different dates. The light line shows the total number of canker-infected properties found in the State up to the end of any given month. The heavy line shows the number of canker-infected properties declared by the Plant Board, up to corresponding dates, as being no longer danger centers. (When these two lines meet, in a diagram of this character, eradication of the disease from the State will have been completed.)

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APRIL 30, 1915, TO APRIL 30, 1916

Civil

During this period four owners of canker-infected properties sought by injunction to restrain the agents of the Plant Board from destroying canker-infected trees in accordance with the provisions of the Plant Act. The Circuit Court issued a preliminary injunction in each of these cases. Upon hearing, these injunctions were dissolved.

In another case the owner of a citrus grove requested an injunction restraining the inspectors of the Board from inspecting his property for citrus canker, alleging that the Florida Plant Act of 1915, authorizing such inspection, was unconstitutional. The Circuit Court of Dade County held the Plant Act to be constitutional and sustained a demurrer to such bill, and upon an appeal, the Supreme Court affirmed the decision of the Court below.

The State Plant Board sought by injunction to restrain the owner of a canker-infected property from interfering with agents of the Board in destroying canker-infected trees as provided for by the Plant Act. A preliminary injunction was issued, the terms of the injunction were alleged by the Board to have been violated and the defendant cited for contempt.

Criminal

Warrants were issued charging two owners of canker-infected properties with refusing to destroy, or to permit destruction of, canker-infected trees. At the end of the fiscal year one of these cases was still pending. In the other case the defendant died before being tried.

A warrant was issued charging the owner of a canker-infected property with picking, packing and shipping citrus fruit from said infected property in violation of the Plant Board rules prescribing the sanitary precautions for handling of such fruit. Preliminary hearing was indefinitely postponed upon payment of costs by defendant and assurances being given of future co-operation with the Plant Board.

A warrant was issued charging a nurseryman with removing plants from a canker-infected property. Case pending at the close of the fiscal year.

An owner of a canker-infected property planted citrus trees therein in violation of Rule 5 of the Board. Upon information

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being filed against this party he plead guilty and was fined $25.00 and costs.

Warrants were issued charging two owners of citrus properties with assault, arising out of the inspection of citrus properties by agents of the Plant Board. One of these was nol-prossed upon assurances of future co-operation with the Board; the other was pending at the close of the fiscal year.

May 1, 1916, to November 30, 1916

Civil

During this period but one case was brought against the Board. Certain nurserymen whose citrus nurseries were located within one mile of property which the Plant Board had by resolution declared to be canker-infected property and hence under quarantine by the provision of Rule 5 of the Plant Board, petitioned the lower court for a decree requiring the Board to abolish its Rule 5 and to require said Board to permit the sale and distribution of citrus nursery stock which, under its rules, was declared to be exposed to danger of infection. To this the attorneys for the Plant Board filed a demurrer. The lower court overruled this demurrer, but the Supreme Court of the State reversed the decision, sustaining this demurrer. In its decision the Supreme Court held that the bill of complaint failed to show that the State Plant Board in making and enforcing Rule 5 had exceeded its authority, and that therefore a court of equity would not be warranted in requiring the Board to abolish or modify its rule.*

Criminal

Warrants have been issued charging four parties with planting citrus trees in areas within which such planting was prohibited by rules of the Plant Board because of danger of infection by citrus canker. These cases are pending at the time of this report.

Warrants have been issued charging two parties with having moved nursery stock without a certificate of inspection attached, as required by the Plant Act. These cases are also pending.

CO-OPERATION

The Plant Board has received the unstinted co-operation and

*The cost to the Plant Board of defending this case, including attorneys' and witness fees, time of its employees, traveling expenses, etc., amounted to $1238.80.

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support of the Florida Growers' and Shippers' League, the Florida Citrus Exchange, marketing agencies and local growers' associations.

The University of Florida Experiment Station, through its Director, Prof. P. H. Rolfs, and several members of its staff, has rendered valuable aid. The assistance of Prof. H. E. Stevens, Plant Pathologist of the Station, in furnishing to the Board and its agents the results of his exhaustive investigations of citrus canker is particularly worthy of mention.

Members of the Faculty of the University of Florida cheerfully contributed their services in the training of inspectors for the canker eradication work. Through the courtesy of President A. A. Murphree, the Plant Commissioner and his assistants have also been supplied with office and laboratory room and their work facilitated in many ways.

During those periods in which the canker eradication work has been conducted in intimate co-operation with the Bureau of Plant Industry, United States Department of Agriculture, the most harmonious relations have existed between the Plant Board staff and the officials of the Bureau. The latter have been untiring in their efforts to facilitate in every way possible a successful campaign against the disease in Florida. Special mention should be made of the interest displayed in this work by the Honorable Secretary of Agriculture, David F. Houston, and the active part taken by Dr. K. F. Kellerman, Assistant Chief of the Bureau of Plant Industry.

Much of the success which may have been attained thus far is in large measure due to the generous support and assistance received from all quarters.

DEPARTMENT OF NURSERY INSPECTION

The nursery is a necessary feature in the horticultural industries, for it is the place in which trees are produced and grown for planting in the groves and orchards. The nursery could not be dispensed with in the development of any fruit industry of commercial importance. However, the nursery, besides being the distributing center for trees and plants, is also the distributing center of all diseases and insect pests to which the grove or orchard trees are subject. Healthy orchards can be insured only by the use of healthy nursery stock, and the latter cannot be insured save by a very efficient and painstaking in-

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spection system which will not only detect dangerous diseases and insects in the nursery, and prevent their distribution to planters, but which will go even further and protect the nurseries themselves against infestation from outside sources. Such a system has been developed by the Plant Board and is confidently believed to be at least the equal of any in the United States.

Practically all of the pests which the pecan growers, peach growers, citrus growers and other horticulturists are now compelled to combat have been introduced into their plantings on nursery stock in past years when adequate nursery inspection was not provided by the State. As there are many destructive diseases and insects—such as citrus canker, scaly bark, cottony cushion-scale, Dictyospermum scale, California red scale, camphor thrips, pecan die-back, etc.—that are not yet generally distributed over the State and as the introduction of additional dangerous enemies can be prevented only by an adequate inspection of both importations and nurseries, the importance of the nursery inspection work of the Board is self-evident.

The first official inspection of nursery stock in Florida was provided for by an Act of the Legislature approved May 23, 1911, the execution of this Act being placed in the hands of the Board of Control. As but $3000.00 per annum was appropriated for this work, which sum had to cover the salary, office expenses and traveling expenses of the one inspector and as the nurseries of Florida during this period contained not less than twelve million trees, the inadequacy of the inspection service at that time is self-evident. The Inspector of Nursery Stock did the best he could with the facilities at his disposal, but it was a physical impossibility for one man, regardless of his efficiency or energy, to annually inspect more than a very small per cent of twelve million trees.

This arrangement continued until the passage of the Florida Plant Act of 1915, immediately following which the nursery inspection work was taken over and entirely reorganized by the Plant Board.

From April 30 to June 1, 1915, the former Inspector of Nursery Stock, Dr. E. W. Berger, assisted by Prof. P. H. Rolfs of the Advisory Committee, supervised the work of nursery inspection. On May 11, 1915, the Board elected Mr. F. M. O'Byrne as Nursery Inspector and he assumed the duties of this position June 1, 1915.

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Among the many striking results of the nursery inspection work the following will serve as examples:

On three occasions citrus canker has been discovered in nurseries by assistant inspectors and distribution of trees from these nurseries prevented.

Scaly bark has been discovered in thirteen localities where it was not previously known to exist, the Board being thereby enabled to take steps for preventing its further dissemination from these centers.

Camphor thrips was discovered in seven nurseries and its distribution from these centers of infestation prevented.

The Dictyospermum scale* was discovered in Florida, and nurseries so located as to be exposed to infestation by this new pest were placed under quarantine.

Foot rot was discovered in three nurseries and these placed under quarantine.

Inspection Work

April 30, 1915, to April 30, 1916

During the fiscal year which ended April 30, 1916, 697 nurseries were inspected. The total number of nursery inspections made was 1,061. The acreage embraced in the 697 nurseries was as follows:

Citrus	1,651 acres
Pecan	471½ acres
Ornamental and general	321 acres
Total	2,443½ acres

The amount of nursery stock (number of trees) in the 697 nurseries inspected was as follows:

Citrus—			
Budded grapefruit	1,822,991		
Budded orange	3,057,699		
Other budded varieties	1,853,953		
Unbudded seedlings	9,995,001		
Total citrus stock		16,729,644*	
Under quarantine April 30, 1916 (for various reasons)		754,016	
Marketable citrus stock April 30, 1916			15,975,628
Pecan—			
Budded	1,784,325		
Seedlings	1,737,975		
Total pecan stock		3,522.300	

*Known to be, in certain European countries, particularly Spain, the most destructive scale-insect affecting citrus trees.

*Dade County not included.

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Pecan stock under quarantine April 30, 1916		150,500	
Marketable pecan stock			3,371,800
Peach—			
Budded	102,680		
Seedlings	96,750		
Total peach stock		199,430	
Under quarantine April 30, 1916		12	
Marketable peach stock			199,418
Plum—			
Budded	22,400		
Seedlings	25,550		
Total		47,950	
Under quarantine April 30, 1916		000	
Marketable plum stock			47,950
General and Ornamental		2,157,793	
Under quarantine April 30, 1916		3,162	
Marketable			2,154,631
Total plants in nurseries recorded April 30, 1916		22,657,117	
Total plants in nurseries under quarantine April 30, 1916		907,690	
Total marketable stock in nurseries recorded April 30, 1916			21,749,427

May 1, 1916, to August 31, 1916

During this period 922 inspections of nurseries were made. A total of 333 nurseries, newly established or not previously known to the Department, were placed under inspection. The acreage in these 333 nurseries was as follows:

Citrus	148½ acres
Pecan	6½ acres
Ornamental and general	24¼ acres
Total	176¼ acres

The amount of nursery stock growing in these "new" nurseries was as shown below:

Citrus—			
Budded grapefruit	125,657		
Budded oranges	253,071		
Other budded varieties	55,530		
Unbudded seedlings	1,409,182		
Dade County citrus nursery stock*	2,037,008		
Total		3,880,448	
Stock in new nurseries under quarantine September 1, 1916		2,196,225	
Marketable citrus stock in newly inspected nurseries**			1,684,223

*The inspection of citrus stock in Dade County is under the direction of the Dade County branch of the Canker Eradication Department.

**At the present time citrus nursery stock in Dade County is permitted moved under package certificate only.

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Pecan—			
Budded	22,250		
Unbudded	19,250		
Total pecan stock		41,500	
Under quarantine September 1, 1916		000	
Marketable pecan stock in newly inspected nurseries			41,500
General and ornamental		116,858	
Under quarantine September 1, 1916		16,409	
Marketable general and ornamental stock in newly inspected nurseries			100,449
Total plants in new nurseries		4,038,806	
Under quarantine September 1, 1916		2,212,634	
Total marketable stock in new nurseries September 1, 1916			1,826,172

QUARANTINES IMPOSED

The discovery of any especially injurious insect or disease in a nursery is the occasion for placing that nursery under quarantine and preventing all movement of stock therefrom. The quarantine may be of short or long duration, according to the promptness with which the owner of the nursery eradicates the pest or disease in question or satisfactorily reduces the danger of infestation to his plants. In no case is the quarantine lifted until all the stock in the nursery is, in the light of all available information, made safe from infection.

April 30, 1915, to April 30, 1916

During the fiscal year quarantines were imposed on 104 nurseries, the reasons therefore being stated below:

Quarantined on account of:	Number of nurseries quarantined
Canker in nursery	3
Located in quarantine zone	16*
Being contact properties**	4
San Jose scale	7
California red scale	4
Camphor thrips	7
Excessive whitefly and scale	63
Excessive citrus scab infection	1
Scaly bark	1
Total	104

*Three nurseries were partly within the quarantined area. They destroyed all stock within the quarantined zone, making possible the release of their remaining stock.

**A citrus property which has been entered by people, teams, implements, or other things which have previously been in a canker-infected property.

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May 1, 1916, to August 31, 1916

During this period, quarantines were imposed as follows:

Quarantined on account of:	Number of nurseries quarantined
Canker in nursery	1
Located in quarantine zone	25
Being contact properties	4
San Jose scale	8
California red scale	6
Camphor thrips	7
Excessive whitefly or scale	137
Excessive scab infection	4
Scaly bark	2
Foot rot	3
Dictyospermum scale	5
Total	202

INSPECTION CERTIFICATES ISSUED

Upon the nursery passing a satisfactory inspection the owner is supplied, upon request, with certificate tags permitting the sale and shipment of stock from his nursery. The certificate tags are serially numbered and the nurseryman is required to account for each tag furnished him by mailing to the Nursery Inspector a duplicate " invoice " listing the stock sold or shipped under that tag, together with the name and location of the party receiving same. The Department therefore has what is presumably a complete record of all trees moved from one place to another in the State. In case a dangerous disease, as for example, citrus canker, is discovered in a nursery, the trees *previously* shipped from that nursery can be located and inspected.

Incidentally, these records afford the most accurate statistics ever compiled regarding the nursery industry of any State.

April 30, 1915, to April 30, 1916

During this period certificate tags were issued to 424 Florida nurseries, 47 individuals, 12 nursery-stock dealers and to 67 nurseries located in other states. In other words, 550 firms and individuals were authorized to market nursery stock, previously inspected and passed, in Florida.

The number of certificate tags issued is shown below:

Regular tags	146,500
Stock-dealers' tags	4,800
Package tags	5,571
Scaly-bark tags	4,600
Florida permit tags	17,090
Total tags	178,561

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May 1, 1916, to August 31, 1916

During this period, certificates were issued to 87 Florida nurseries, 20 individuals, 1 nursery-stock dealer and 14 nurseries in other states; total, 122. The number of certificate tags issued was as follows:

Regular tags	36,400
Stock-dealers' tags	1,100
Package tags	791
Scaly-bark tags	5,455
Florida permit tags	2,007
Total	45,753

Number of Shipments

The records of the Department afford the following interesting data on the amount of nursery stock moved within, into and out of Florida during the fiscal year which ended April 30, 1916:

Number of shipments made by Florida nurseries	33,750
Number of shipments made into Florida by nurseries in other States	5,400
Number of States into which Florida nurseries shipped	48
Number of foreign countries into which Florida nurseries shipped	28
Number of shipments made by Florida nurseries into foreign countries	230
Number of States from which shipments were made into Florida	28

Miscellaneous

Experimental work is not contemplated by the Board except where such work is necessary for the development or improvement of methods for the control or eradication of plant diseases or insect pests, the prosecution of experimental work, *per se*, being considered within the province of the University of Florida Experiment Station.

The advantage of citrus growers being provided with trees practically free from citrus scab has made evident the desirability of nurserymen being required to produce trees essentially free from this disease. Before imposing this requirement upon the nurserymen, however, it is necessary to demonstrate that a satisfactory control of the disease on nursery stock is both possible and practicable. With this in view the Nursery Inspection Department established, during 1915, a citrus nursery of 3600 seedlings and commenced experimental spraying with various fungicides. Severe drouth, immediately following the planting of the seedlings, resulted in the loss of many of them, necessitating replantings before the nursery could be made ready for experimental work. The experiments are now under way and give promise of yielding satisfactory results.

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The Department has co-operated with the Department of Entomology in securing and furnishing to growers colonies of the Australian lady-bird beetle for control of the cottony cushion-scale. During the fiscal year ending April 30, 1916, assistant nursery inspectors collected for this purpose 354 of the lady-bird beetles, and between April 30 and August 31, 1916, 551, or a grand total of 905; a sufficient number to bring about prompt control of the cottony cushion-scale in at least 1,000 acres of citrus groves.

The work of the Department has been presented to the public through addresses before association meetings, the Citrus Seminar, articles in the press of the State and by correspondence. Not the least valuable of the services rendered by the Department has been direct advice to nurserymen as to the particular means by which they could prevent infection or infestation of their nursery stock, thus protecting their investments as well as those of their customers.

Grand Summary

The inspection work done by the Department, from the creation of the Plant Board, April 30, 1915, to August 31, 1916; as well as the amount of marketable stock in the Florida nurseries on August 31, 1916, is shown in the following summary covering the sixteen-months' period:

Total number of nurseries inspected			1,030
Total number of inspections made			1,983
Total acreage of stock in nurseries listed			2,619¾
Citrus nursery stock:			
Budded grapefruit	2,146,815		
Budded oranges	3,752,385		
Other budded varieties	1,269,701		
Unbudded seedlings	9,404,183		
Dade County citrus	2,037,008		
Total citrus nursery stock in State		18,610,092	
Citrus nursery stock under quarantine August 31, 1916		3,579,607	
Marketable citrus stock in Florida nurseries			15,030,485
Total general and ornamental stock		2,274,651	
Under quarantine, August 31, 1916		72,954	
Marketable general and ornamental stock			2,201,697
Pecan buds	1,806,575		
Pecan stock	1,757,225		
Total pecan stock		3,563,800	
Under quarantine, August 31, 1916		422,805	
Marketable pecan stock			3,140,995

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Peach buds	114,960		
Peach stock	96,750		
Total peach stock		211,710	
Under quarantine, August 31, 1916		18,912	
Marketable peach stock			192,798
Plum buds	22,400		
Plum stock	25,550		
Total plum stock		47,950	
Under quarantine, August 31, 1916		6,700	
Marketable plum stock			41,250
Total plants in Florida nurseries		24,708,203	
Under quarantine, August 31, 1916		4,100,978	
Marketable plants in Florida nurseries, August 31, 1916			20,607,225

Certificate Tags Issued

Total Florida nurseries receiving tags	511
Individuals receiving tags	67
Stock dealers receiving tags	13
Out-of-State nurseries receiving tags	81
Total	672

DEPARTMENT OF PORT AND RAILWAY INSPECTION

Protection of the agricultural and horticultural industries against the further introduction of destructive pests and diseases was one of the principal objects of the Florida Plant Act of 1915.

It is significant that citrus canker has not obtained a foothold in California, where a horticultural quarantine service has been maintained for thirty years. Canker-infected nursery stock has been several times intercepted by the California quarantine inspectors and the freedom of the California citrus industry from canker thus far can be ascribed only to the success of that State's quarantine inspection.

There had been expended in the campaign of eradicating canker in Florida, up to September 30, 1916, approximately $432,462.44* from all sources. This amount expended in preventing the *introduction* of this disease would have maintained a system of efficient port and railway inspection for over 30 years.

*See page 66.

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During the autumn months of 1915, an assistant nursery inspector was detailed for short periods to examine incoming shipments of nursery stock at Jacksonville. This preliminary inspection work revealed the fact that comparatively few of the nurseries shipping stock into Florida from other states were complying with the Florida Plant Act and many shipments were brazenly consigned to Florida points without even being accompanied by inspection certificates of any kind. Many of these shipments were found infested with injurious insects and diseases.

The urgent necessity for organizing the Plant Board forces in the fight against citrus canker during the summer of 1915 unavoidably delayed inauguration of the port and railway inspection work. This was commenced, however, by the appointment on December 13, 1915, of Mr. W. N. Hull as semi-volunteer deputy inspector at Miami. This was followed by the appointment of deputy inspectors at Pensacola on January 15, 1916; at Jacksonville and Tampa on January 24, 1916; and at Key West on March 23, 1916. Most of these deputy inspectors had received previous training both in the citrus canker eradication work and in the nursery inspection department, while the remaining ones were selected on account of special fitness due to their previous experience in similar lines of work.

Many shipments of plants infested with common, more or less destructive, pests and diseases have been intercepted, and much more material not actually showing infection, but considered dangerous because of its origin, has been prevented delivery in the State.

On one occasion a shipment of citrus budwood, from a canker-infected property in another State, was intercepted while on its way to a Florida citrus nursery. It is not impossible that the stoppage of this one shipment, by preventing subsequent expenditures for stamping out canker outbreaks which might have resulted had the shipment reached its destination and infected the nursery in question, saved the State more than the entire port and railway inspection work would cost for several years.

Upon inauguration of the port and railway inspection service arrangements were made with the Federal Horticultural Board of the United States Department of Agriculture whereby the deputy inspectors of the State Plant Board received appointments as agents of the Horticultural Board with authority to enforce all Federal rules and regulations relative to the import-

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ation of plants and plant products. While the State Plant Board must necessarily assume the expense of all inspection, the work is greatly facilitated by reason of the deputy inspectors being Federal appointees, particularly as this arrangement makes possible a close co-operation between the inspectors and the customs officials at all the ports of entry. The customs inspectors have, without exception, rendered cheerful and valuable co-operation and assistance in the inspection of all importtations subject to the rules of the Federal Horticultural Board.

It is a pleasure to report that the officials, as well as local representatives, of the steamship and railway companies and of the Southern Express Company have offered our inspectors every facility for inspecting shipments and have in addition been diligent in securing compliance, upon the part of their employees and connections, with the regulations governing such shipments. In the few instances where shipments have been moved in violation of some rule of the Board it has been found that such movement was due to misunderstanding or ignorance of the requirements and steps have in all cases been promptly taken to remedy any dangerous conditions which may have been created by these violations.

The work accomplished by this Department is shown by the following summaries:

December 13, 1915, to April 30, 1916

Ships and vessels inspected:		
From foreign ports	166	
From United States ports other than Florida	52	
From Florida ports	152	
Total vessels inspected		370
Shipments inspected:		
Arriving by water:		
Passed	67	
Treated and passed	6	
Returned to shipper	2	
Contraband destroyed	40	
		115
Arriving by express or freight:		
Passed	319	
Treated and passed	9	
Returned to shipper	16	
Detained, subject to return by owner	12	
Contraband destroyed	29	
		385
Total shipments inspected		500

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Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of shipments infested
Whitefly	Citrus	Florida	3
Whitefly	Citrus	Cuba	2
Whitefly	Begonia	Cuba	1
Whitefly	Begonia	Florida	1
Long scale	Citrus	Florida	1
Purple scale	Citrus	Florida	1
Purple scale	Hibiscus	Cuba	1
Florida red scale	Citrus	Jamaica	1
San Jose scale	Oleander	Mexico	1
San Jose scale	Oleander	Guatemala	1
Cottony cushion-scale	Citrus	Cuba	1
Cottony cushion-scale	Citrus	Mexico	1
Rufus scale	Citrus	Cuba	1
Latania scale	Latania Palm	Illinois	1
Diaspis sp.	Raspberry	Tennessee	1
Soft scale	Palm	Louisiana	1
Red spider	Rose	Cuba	5
Elm tree borer	Elm	North Carolina	1
Peach-borer	Peach	Indiana	1
Camphor-thrips	Camphor	Florida	2
Root-knot	Peach	Florida	2
Root-knot	Fig	Florida	1
Root-knot	Fig	Texas	1
Root-knot	Fig	Georgia	4
Root-knot	Fig	Alabama	1
Root-knot	Peach	South Carolina	2
Root-knot	Peach	Georgia	1
Root-knot	Elderberry	Florida	1
Root-knot	Elaeagnus	Pennsylvania	1
Root-knot	Blackberry	Iowa	1
Citrus scab	Citrus	Cuba	1
Citrus scab	Citrus	Florida	1

May 1, 1916, to September 30, 1916

During this period the work of this Department was continued without interruption. A summary of the inspections is here given:

Ships and vessels inspected:
- From foreign ports 356
- From United States ports other than Florida 172
- From Florida ports 429

Total vessels inspected 957

Shipments inspected:

Arriving by water:
- Passed 89
- Treated and passed 17
- Returned to shipper 23
- Contraband destroyed 203

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Arriving by express or freight:

Passed	319	
Treated and passed	65	
Returned to shipper	27	
Detained, subject to return by owner	53	
Contraband destroyed	54	
		518
Total shipments inspected		850

Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of shipments infested
Whitefly	Citrus	Florida	3
Whitefly	Jessamine	Florida	2
Whitefly	Privit	Florida	1
Whitefly	Hibiscus	Florida	1
Whitefly	Jessamine	Georgia	1
Whitefly	Citrus	Cuba	2
Whitefly	Citrus	Honduras	1
Long scale	Citrus	Florida	2
Purple scale	Citrus	Florida	8
Purple scale	Citrus	Cuba	1
Florida red scale	Mango	Florida	1
Chaff scale	Citrus	Florida	2
Chaff scale	Shrubs	Cuba	1
California black-scale	Poinsettia	Florida	1
California black-scale	Jessamine	Florida	1
San Jose scale	Pear	Florida	1
San Jose scale	Rose	Florida	1
Oyster-shell scale	Maple	Pennsylvania	1
Turtle-back scale	Jessamine	Florida	1
Florida wax-scale	Mango	Florida	1
Howard's scale	Gooseberry	Wisconsin	1
Snow scale	Hibiscus	Florida	1
Snow scale	Soursop	Cuba	2
Snow scale	Soursop	Mexico	1
Chrysomphalus oleae	Palm	Georgia	1
Cottony cushion-scale	Citrus	Cuba	1
Cottony cushion-scale	Citrus	Mexico	2
Cottony cushion-scale	Citrus	Florida	3
Rufus scale	Cutting	Cuba	1
Mealy-bug	Coleus	Michigan	1
Mealy-bug	Rose	Florida	1
Mealy-bug	Sugar Apple	Cuba	1
Aphids	Geraniums	Florida	1
Strawberry leaf-roller	Strawberry	Wisconsin	1
Red spider	Rose	Cuba	1
Papaya fruit-fly	Papaya	Florida	1
Papaya fruit-fly	Papaya	Florida	2
Root-knot	Poinsettia	Florida	1
Root-knot	Fig	Florida	2
Root-knot	Austral'n Silk Oak	Florida	1
Root-knot	Cassava	Florida	1
Root-knot	Chrysanthemum	Florida	1
Root-knot	Peach	Florida	2
Root-knot	Hibiscus	Florida	3
Root-knot	Jessamine	Florida	1
Crown gall	Peach	New York	1
Phomopsis sp.	Mango	India	1
Melanose	Citrus	Florida	1

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As the deputy port and railway inspectors also examine and inspect shipments of trees and plants enroute from one point to another within the State a check is secured upon the shipments made by nurseries holding the certificates of the Plant Board. Any misuse of these certificates is quickly detected. Many uncertified shipments, frequently infested, between points within the State have been intercepted. Where such material is apparently free of injurious pests and diseases and the evidence at hand indicates that it has not been exposed to infection it is passed and permitted to proceed to the consignee, while the consignor, on the other hand, is courteously advised by mail as to the rules of the Board requiring the certification of trees and plants prior to their shipment.

Boll Weevil and Pink Boll-Worm Quarantines

Enforcement of the Board's rules relative to the quarantine on shipments likely to disseminate the cotton boll weevil comes within the work of this Department.

Prior to the establishment of a Plant Board, the Board of Control, through the Inspector of Nursery Stock, established a quarantine on cotton seed, cotton seed hulls, and other products likely to carry the cotton boll weevil from infested territory into the portion of Florida not yet reached by this insect. This quarantine, in an improved form, was continued by the State Plant Board.

The boll weevil has two methods of distribution. One is by annual migratory flight, by means of which the insect usually advances from 30 to 40 miles into new territory. The other is distribution in cotton seed, cotton seed hulls, Spanish moss and certain other products shipped from the weevil-infested territory to other cotton-growing areas. While no human agency can prevent the annual migration of the boll weevil into new territory, it is gratifying to know that this pest has been prevented, by means of the Plant Board's quarantines, from taking advantage of express, railway and water shipments to increase its range of destructiveness. While it is quite certain that all the cotton-growing sections of Florida will eventually be invaded by this insect, the Plant Board will continue to impose all possible obstacles to the spread of the weevil, thus protecting the cotton-growing sections not yet infested just as long as possible.

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The provisions of this quarantine are found in Rule No. 18 of the Board.

To prevent commercial interests from taking advantage of the restricted movement of cotton seed and cotton seed hulls to advance prices on these commodities the Board, in December, 1915, devised a plan by which cotton oil mills located in weevil-free territory could receive and mill cotton seed from weevil-infested sections without danger of disseminating the boll weevil, such milling being done under the inspection of Plant Board inspectors.

At the close of the cotton-growing season of 1915 the eastern limit of the boll weevil-infested territory was in Hamilton, Madison, and Taylor Counties. During the late summer and autumn of 1916 the weevil, by means of its annual migratory flight, occupied additional territory to the eastward, the eastern limit of the infested territory in November, 1916, running through the Counties of Nassau, Duval, Clay, Bradford, Alachua and Levy. The exact limits of the infested territory were carefully determined by inspectors of the Plant Board, by means of actual field examinations, as a basis upon which the quarantined area was established.

As there are still several thousand acres of land normally devoted to cotton-growing in the area not yet invaded by the weevil the wisdom of continuing the present quarantine is self-evident.

The recent discovery of the pink boll-worm in Mexico has caused considerable alarm among cotton growers throughout the entire South. This pest, which evidently originated in India, is much more destructive than the boll weevil, and there is no reason for not supposing that its introduction into the Gulf States would result in the practical ruin of the cotton industry. This insect is readily transmitted in shipments of cotton seed from infested areas, and while the United States Department of Agriculture, through the Federal Horticultural Board, is maintaining along the Mexican border an effective quarantine against shipments of cotton seed from Mexico, the deputy inspectors of the State Plant Board are keeping a rigid watch for the arrival of any cotton seed from Mexican points on steamers arriving at the ports of this State.

Gypsy and Brown-Tail Moth Quarantine

The Gypsy moth and brown-tail moth, pests occurring in the

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New England States and against which a vigorous campaign is being waged by the United States Department of Agriculture as well as by the several States infested, are pests capable of being introduced into Florida with commercial shipments of various kinds. As these insects are very destructive in certain European countries in which the climatic conditions are practically the same as those of Florida, there is no reason for not supposing that they would be equally as destructive here.

Although all material likely to transmit these pests is carefully inspected by agents of the Department of Agriculture before it is allowed to leave the infested territory, it is deemed advisable to take even further precautions against infested material being shipped into Florida.

With the aid of the United States Department of Agriculture a list has been compiled of the shipments of trees, boxbands and similar materials made during the past few years from New England points to Florida. During the summer of 1916, Deputy Inspector George B. Merrill was detailed by the Plant Commissioner to make inspections of the forest and ornamental plants on all premises where such shipments had been received or used. This work embraced the inspection of 43 premises, located in or near 24 towns, in 17 Counties of the State. It is a matter for congratulation that no evidences of either pest were found by Mr. Merrill.

SUMMARY

The occurrence of the Morelos fruit worm and the pink bollworm of cotton in Mexico, the avocado weevil in Central America, the spiny citrus whitefly in Jamaica and the Bahamas, the pineapple borer in Jamaica, the Gypsy and Brown-tail moths in New England and the Mediterranean fruit fly in Bermuda, the Azores, France, Spain, Hawaii and many other sub-tropical countries, citrus canker in the other Gulf States and brown rot of lemons and oranges in California, make it imperative that the Port and Railway Inspection service not only be continued but that it be made much more thorough than is possible with the funds at present available.

Of the pests and diseases mentioned above, but one, citrus canker, has thus far secured even a temporary foothold in Florida. Introduction of any of the others would mean to the State the same menace and the same expense for eradication now being experienced in the case of citrus canker. Indeed,

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it is doubtful if some of the pests mentioned could be eradicated at any cost, once they become established. The Mediterranean fruit fly, for example, has never been eradicated in any of the countries where it has become established, despite appalling expenditures and the most desperate efforts on the part of governmental officials and experts.

An efficient quarantine service, to keep these destructive agencies permanently out of our State, is therefore imperative and funds thus expended will constitute insurance of the most valuable kind.

DEPARTMENT OF ENTOMOLOGY

At its first meeting, the Plant Board elected Dr. E. W. Berger, former Inspector of Nursery Stock, as Entomologist. As a Nursery Inspector was not provided for at that time, it was necessary for Dr. Berger, working in conjunction with Prof. P. H. Rolfs of the Advisory Committee, to continue the nursery inspection work until Mr. F. M. O'Byrne assumed the duties of Nursery Inspector on June 1, 1915. The Entomologist was without regular assistance in his office, except for stenographic help, until January 3, 1916. Upon the latter date, Mr. A. C. Mason, after election by the Board, assumed the duties of temporary assistant to the Entomologist.

At the time of Dr. Berger's appointment, this Department, like all other Departments of the Plant Board, was without equipment, the laboratory apparatus, collections, etc., which had been used by the Inspector of Nursery Stock having belonged to the Florida Experiment Station or to himself. It was necessary first of all to equip the Entomological Department with microscopes, glassware, scales, insecticides, etc., and to construct an insectary and laboratory in the attic of Language Hall for the carrying on of the principal work of this Department. A general laboratory for identifying and preserving specimens, and containing the office of the Entomologist, was equipped on the second floor of Language Hall.

Three principal lines of work have been conducted by the Entomological Department; namely, the growth and distribution to citrus growers of the red Aschersonia, or red whitefly fungus, used for control of the whitefly; distribution of colonies of the Australian lady-bird beetle, for control of the cottony

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cushion-scale, and experiments made in the attempt to devise a satisfactory treatment for camphor trees infested with the camphor thrips.

Red Whitefly Fungus

For some years past citrus growers in Florida have been accustomed to inoculate the whitefly larvae on the citrus trees with this parasitic fungus by spraying the trees with water in which had been mixed leaves from groves where the fungus occurred. This method, while giving the desired results so far as control of the whitefly is concerned, also incurred considerable risk of distributing any citrus diseases which occurred on the trees from which the leaves were taken. The use of citrus leaves in this manner in sections where citrus canker occurred was seen to be particularly dangerous. It was, therefore, highly desirable that citrus growers be afforded a source of supply for this fungus which was safe from contamination by citrus canker, scaly bark, and other diseases.

Prof. H. S. Fawcet of the Florida Experiment Station had, during the period from 1907 to 1911, devised a method of growing this fungus in pure cultures on a small scale, using pieces of sterilized sweet potato in wide-mouthed bottles. During the winter of 1915-16 the entomological laboratory was equipped with a sterilizer and the necessary atomizers, glassware, etc., for producing this fungus. It was planned to produce a sufficient number of cultures so that all fruit growers who desired could secure them and the work was undertaken on a large scale. From January to April, 1916, 276 cultures were prepared and of this number 147 or 53 per cent produced spores and developed into proper condition for use in the citrus groves. These were distributed to growers requesting them, at the proper time, a nominal charge of 50 cents per culture being made to cover the actual cost of material used in preparation of each culture. As this was the first attempt ever made to produce this fungus in commercial quantities, some difficulties were encountered in securing proper fruiting or production of spores. However, the securing of 53 per cent of fruited cultures from the total number inoculated appears to have been as great as could have been expected in the absence of previous experience on a large scale.

During the period from May 1 to August 31, 1916, 1,820 cultures were inoculated. Of this number only 211 produced spores

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and were suitable for use in the field. It was found that during the warm weather the fungus did not develop as well as during the cooler winter months, and after some experiment it was found that by keeping the developing cultures in an ice-box or placing them under buildings where the temperature was lower, fruiting of the fungus was facilitated. There were accordingly distributed by the Entomological Department up to August 31, 1916, a total of 358 cultures which were used by the citrus growers receiving them. As one culture is sufficient to inoculate the whitefly in one acre of citrus trees, the growers were enabled by the use of this material to spray at least a corresponding number of acres. Only a limited number of the growers receiving this material reported upon its use, but out of those which reported, over 50 per cent reported excellent results.

The value of this fungus for the control of the whitefly has been shown to be very great. The use of pure cultures by the growers is not accompanied by the risk of introducing other insects or diseases into their groves and the cost at which the material can be prepared is merely nominal. It was impossible, with the amount of material which the Department was able to produce with its limited resources, to anywhere nearly supply the demand of the citrus growers for this material. Plans are being made to produce it upon a much larger scale during the coming year in the hope that sufficient cultures can be furnished for general use in all sections of the State where the whitefly is known to occur.

AUSTRALIAN LADY-BIRD BEETLES

The Australian lady-bird beetle, or Vedalia, has been found fully as efficient in controlling the cottony cushion-scale in Florida as in California and other States where it has been employed for this purpose. The control of this scale-insect, brought about by the lady-bird beetle, is practically complete. In fact, the lady-bird beetle destroys the scale so thoroughly that the resulting scarcity of the latter results in a marked reduction or disappearance of the beetles because their food supply is exhausted. This, in turn, is usually followed by an increase of cottony cushion-scale. For this reason it becomes necessary to "re-introduce" the lady-bird beetle into cottony cushion-scale areas from time to time. Attempts have been made by the Entomological Department to raise the lady-bird beetles in captivity in large quantities so that a supply would always be

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available. These experiments were not successful but it was found possible to keep living lady-bird beetles in cold storage for a considerable time and it was also found that supplies of cottony cushion-scale, on which young Vedalia could be raised to maturity, could also be kept in cold storage for a considerable time.

In addition to the lady-bird beetles raised in the Department, others were collected in different sections of the State under a co-operative arrangement with the Nursery Inspection Department, so that it has been possible, with few exceptions, to promptly meet the requests of the growers in the cottony cushion-scale areas. The fact that private parties have at various times sold these lady-bird beetles at a price as high as $1.00 each shows the value which is attached to them by the growers. It has been the practice of the Entomological Department to charge for colonies of these beetles only the estimated actual cost of rearing them or of collecting them in different sections of the State and a uniform price of $1.00 for a colony of ten beetles has been charged. Charging a nominal sum covering the cost of furnishing these insects insures the supply being distributed only to those growers who are actually in need of them.

CAMPHOR-THRIPS

In certain sections of the State camphor trees have been subject for some years past to a severe infection which not only marred their appearance but in many cases killed the trees. Through investigations made by Prof. J. R. Watson, Entomologist of the Florida Experiment Station, it was found that this infection was due to a minute insect described by him as the camphor-thrips. The appearance of this pest in several nurseries where camphor trees were grown made it advisable for the Entomological Department of the Plant Board to determine. if possible, whether any treatment could be applied to the infected trees whereby they could be completely freed from the insect and the resulting infection. During March, 1916, 300 infested camphor trees were secured, planted in separate lots on the University farm at Gainesville and treated with various insecticides. At the time of writing this report, August 31, 1916, it is not considered that sufficient time has elapsed for safe conclusions to be drawn as to the effectiveness of these various treatments. However, one of the treatments, consisting of a two per cent oil emulsion applied to the infested trees after

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they were severely cut back, gives promise of being both an efficient and practical method for treating infested nursery trees prior to shipment.

Incidental Work

The incidental work of the Entomologist and his assistant consists of answering numerous inquiries from farmers and fruit growers regarding injurious insects, the compilation of special information required by other Departments of the Plant Board concerning injurious insects and their habits, the preparation of special reports on insects both in Florida and in other countries for the information of the Plant Board members and the Plant Commissioner, and the preservation of specimens for future reference and information. Careful records are also kept as to the distribution of injurious insects in the State, as this information has an important bearing upon the quarantine measures adopted from time to time by the Board.

During the fiscal year which ended April 30, 1916, the Entomologist delivered addresses on entomological subjects before ten public meetings, and during the period from May 1 to August 31, 1916, before seven meetings.

In co-operation with the College of Agriculture of the University, the Entomologist has constructed a substantial fumigating box which is used jointly for experimental purposes and for fumigating infested material which requires such treatment before it can be safely delivered to Florida customers.

The Entomologist has also conducted experiments with a combination spray of Bordeaux mixture and linseed oil which gives promise of being a preparation which will combine both the qualities of Bordeaux mixture and of a contact insecticide and which will, at the same time, adhere to foliage and bark for long periods of time. Further experiments with this and related spraying preparations will be continued.

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DEPARTMENT OF PLANT PATHOLOGY

April 30, 1915, to April 30, 1916

While the object of this Department is to make such investigations as will facilitate the control or eradication of various diseases of fruit and crops, the critical condition brought about by the occurrence of citrus canker demanded that all efforts be concentrated on a study of this disease for the time being.

At its meeting on July 12, 1915, the Board elected Dr. R. A. Jehle, of Santiago de las Vegas, Cuba, as Assistant Plant Pathologist. Dr. Jehle was assigned to duty in Dade County and commenced his work on August 5, 1915.

As the laboratory building at Redland was then still in course of construction by the South Dade Fruit Growers' and Truckers' Association, Dr. Jehle took up studies of citrus canker under field conditions, working in co-operation with the inspection forces. Careful investigation was made of the agencies by which citrus canker is disseminated as well as of the susceptibility to the disease of different citrus host plants.

Upon completion of the laboratory building every effort was made to equip the laboratory as quickly as possible. On account of many needed supplies being of exclusive European manufacture much delay was experienced in securing them. A water-supply plant and gas plant were also installed, and a doubly screened, storm-proof cage constructed in which citrus canker could be safely studied on its host plants, namely, growing citrus plants. An instrument for registering the temperature and humidity within the cage was installed, as were also instruments for keeping accurate record of weather conditions throughout the year.

The laboratory was formally opened on November 27, 1915, even though all necessary equipment had not at that time been installed.

It was necessary, first of all, to develop methods of preparing cultural media upon which the organism* causing citrus canker could be grown and studied, as well as to perfect methods of inoculation, record-keeping, etc.

Among the first experiments undertaken were those in which ripe citrus fruits, which had been picked, were inoculated with citrus canker bacteria. In no case did such fruit develop canker lesions, though grapefruit seedlings inoculated from the same

*Bacterium citri ("Pseudomonas citri") Hasse.

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cultures developed the lesions in abundance. This result but confirmed observations previously made in the field to the effect that mature picked fruit would not develop visible canker as the result of contamination at the time of picking. Innumerable cases of canker-infected fruit* have been found on canker-infected trees but in such instances the lesions developed while the fruit was immature and still attached to the tree. These results do not indicate, however, that citrus fruits do not serve as mechanical carriers of the organism or that fruit from canker-infected properties can safely be marketed in citrus-growing sections.

During this period experiments were commenced to determine the effect of various disinfectants upon the canker organism. Investigations were also begun with a view to determining whether any remedy for citrus canker could be devised. Practically all of the commonly used fungicides and disinfectants have been investigated in this connection. However, it was found that even substances which would kill the canker organism upon coming in contact with it would not serve as remedies for they could not reach or affect those bacteria which were already within the plant tissue. In like manner; substances sufficiently caustic or penetrating to reach bacteria in the tissues were as destructive to the trees as the citrus canker itself.

Not the least in importance of the work done at the laboratory has been the identification of numerous specimens and verifying, by laboratory methods, the diagnoses of infected trees by the field inspection forces. Numerous specimens of citrus canker, on various citrus host plants, have been preserved, after suitable disinfection, both as records of the infections themselves and for future study and reference.

May 1, 1916, to November 30, 1916

During this period the investigations already under way were continued and additional lines of investigation inaugurated.

Observations of the disease on different host plants showed them to be susceptible to the disease in the following order: pomelo (grapefruit), ponderosa lemon, key lime, Citrus trifoliata, sour orange, tangelo, sweet orange, tangerine, king orange, mandarin-lime and kumquat. That is, the pomelo was found

*In some instances such fruit has been so badly infected that it was shriveled and virtually mummified.

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most readily infected and subject to the greatest damage, while the kumquat was least susceptible.

Tests of disinfectants showed that the canker bacteria are killed by direct exposure to corrosive sublimate solution, at a strength of 1 part to 1,000 parts of water, for a period of one minute. As this disinfectant had been used for some months previously in connection with the field work for disinfecting inspection suits, implements, etc., it was gratifying to learn that careful laboratory experiments confirmed previous opinions as to its efficiency for these purposes. Five per cent carbolic acid and a two per cent formaldehyde solution were also found to be efficient destroyers of the canker bacteria, as was also formaldehyde gas, produced by generating the gas from 10 cubic centimeters of formaldehyde and 5 grams of potassium permanganate to each 13 cubic feet of space in the fumigating chamber. Numerous other disinfectants were tested, the majority of them proving ineffective.

In studying the ecology of the disease it was found that it was most severe and the incubation period shortest during warm, moist weather. The disease was also found to develop most rapidly on citrus trees in a vigorous growing condition.*

All supposed canker "cures" submitted by parties not affiliated with the canker eradication work have been carefully investigated. Those which have given even the slightest promise of possible usefulness have been tested. In no case has any supposed remedy submitted proved to possess any efficacy.

Experiments are under way in developing methods of satisfactorily disinfecting non-citrus trees and plants grown in canker-infected citrus properties. On account of the danger of soil infection such plants may serve as mechanical carriers of canker bacteria. The satisfactory conclusion of these experiments will provide the means, in many instances at least, by which non-citrus trees and plants, such as avocado, mango,

*At first sight it would appear that trees which had been exposed to the infection should be kept in as dormant a condition as possible, cultivation and fertilization refrained from and growth discouraged in every way. However, exactly the reverse is true. If a tree has become infected with the organisms they apparently do not die, no matter how long the tree is kept in a semi-dormant or neglected condition, but persist until active growth does occur, when the canker lesions become visible. It is therefore desirable that the infection be "brought out" on infected trees as quickly as possible, in order that the infected ones may be detected so that they will no longer constitute sources of infection for other trees. The best results in the eradication work have been secured by giving the best of care and attention to trees suspicioned of being infected, thus developing, and removing, all infections present in the shortest time possible. So clearly is this recognized in localities where canker has occurred that neglected or abandoned citrus groves are looked upon as public menaces.

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peach, pecan, etc., can be removed from canker-infected properties and safely used for planting purposes elsewhere.

The Assistant Plant Pathologist has prepared an article on "Means of Identifying Citrus Canker," describing the appearance of the disease and illustrated with both colored and halftone plates. This article was published in the "Quarterly Bulletin" of the Plant Board, Vol. 1, No. 1.

The demand from citrus growers for complete and exhaustive information regarding citrus canker has been insistent. Dr. Jehle has accordingly prepared an extended treatise on the history, economic importance and etiology of the disease, the cultural characteristics and pathogenesis of the organism causing it, the effects of various disinfectants and the bearing of this information upon the practical work of eradicating the disease. Space forbids the presentation of this article here but it is planned to publish it in the Quarterly Bulletin of the Board at an early date.*

CO-OPERATION WITH FOREIGN GOVERNMENTS

The proximity to Florida of many sub-tropical islands and countries in which dangerous insects and diseases are likely to occur renders it of the utmost importance that the Plant Board should be fully informed regarding such pests as may be introduced therefrom into Florida through commercial channels.

The Bahamas

Persistent reports to the effect that citrus canker occurred in The Bahamas, coupled with the fact that there is a constant heavy travel and considerable commerce between The Bahamas and Miami and Jacksonville, resulted in the Plant Board sending Dr. J. H. Montgomery, of its canker eradication staff, to Nassau in May, 1916, for the purpose of investigating these rumors. Dr. Montgomery was most cordially received by His Excellency, Sir William Allardyce, Governor of The Bahamas, and also by the Acting Colonial Secretary, Honorable T. E. D. Brace, and every facility placed at his command for investigating conditions in the islands.

Doctor Montgomery's investigations did not reveal the pres-

*Published in The Quarterly Bulletin, Vol. I, No. 2.—Editor.

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ence of citrus canker in The Bahamas but did bring to light the existence there of a little-known but very destructive insect known as the " spiny citrus white fly ". Many citrus trees had died from its attacks, while many others had been cut down by their owners after ineffectual efforts to control the pest. The insect was also found to attack avocado, mango and other trees.

As a result of this information the Plant Board was enabled to take prompt measures in keeping this pest out of Florida. It has since been learned that this pest occurs in Jamaica as well as in a very limited area in Cuba. There can be little doubt but what this insect, if once established in Florida, would rival citrus canker in destructiveness, but unlike the latter disease would also attack a large variety of other trees and plants.

Subsequent to Dr. Montgomery's visit to The Bahamas the Colonial Legislature passed a Plant Protection Act, not unlike the Florida Plant Act of 1915, and a systematic attempt is now being made there to control the spiny citrus white fly.

CUBA

As early as 1914, those interested in canker eradication in Florida established cordial relations with the Cuba Experiment Station, furnishing the Plant Pathologist of the Station, Prof. John R. Johnston, with information regarding citrus canker and receiving in return information as to conditions in Cuba.

On July 3, 1916, the President of Cuba signed a decree creating the " Comision de Sanidad Vegetal ", or Commission of Plant Sanitation. Under the direction of this Commission active measures have been taken to repress the spiny citrus white fly in the limited area in which it occurs and eradication of the pest from Cuba is anticipated.

A survey of the citrus areas of Cuba has also been made with the gratifying result that no citrus canker has been found.

The control or repression of dangerous insects and diseases in adjacent countries affords a large degree of protection to Florida by reducing the chances for these pests gaining a foothold here. In like manner the Plant Board of Florida cannot obtain an adequate knowledge of conditions in nearby countries save through co-operation with the officials in charge of corresponding work therein. It is hoped that the cordial co-operative relations already established with the government officials of Cuba and The Bahamas can shortly be extended to other governments in the West Indies and Central America.

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ENDORSEMENTS OF THE PLANT BOARD'S WORK

The work being conducted by the Plant Board has been the subject of many favorable comments in the press of the State as well as in publications of other States, particularly California.

Hundreds of letters commending the Board on its activity in not only waging an active eradication campaign against canker, but against many other diseases and insects, are on file in the Plant Commissioner's office at Gainesville.

Resolutions of similar tenor have been adopted by many fruit growers' associations and meetings of various kinds. Special mention should be made of resolutions adopted by the Florida State Horticultural Society in April, 1916, and by a mass meeting of citrus growers at Gainesville in October, 1916. These resolutions were as follows:

RESOLUTIONS ADOPTED BY THE FLORIDA STATE HORTICULTURAL SOCIETY AT ARCADIA, APRIL 26, 1916

The Committee on Resolutions presented the following:

"Mr. Tenny: 'Mr. Chairman, those of us who have been closely associated with the demonstration work under the Plant Act have been impressed with one thing, namely, that the only appropriation carried in the Act itself is not going to be sufficient to carry the demonstration work of the Plant Board as it should be carried in order to properly protect our interests. When the sum of $35,000.00 was suggested and when we went to Tallahassee to ask for that sum we thought it would be ample, but the development of the work has been so rapid and the fields of endeavor have broadened so widely that the sum is really not over fifty per cent of what we need to carry out our ordinary work that comes under the scope of the Plant Act. This, you understand, is entirely aside from the citrus canker work that we hope is more or less temporary, and is an annual appropriation that will go on indefinitely. Therefore, in order to meet the situation, we present the following resolution:'

"WHEREAS, the present annual State appropriation of $35,000.00 will not furnish sufficient funds to do this, therefore, be it

"RESOLVED, that the Florida State Horticultural Society, assembled in annual session, recommend to the State Plant Board that in their estimate to be prepared for and presented to the next session of our State Legislature, they increase the amount estimated for the administration of the Plant Act to a sum sufficient to carry out the provisions of this law in a way that will protect the Agricultural and Horticultural interests of the State."

(Resolution seconded and adopted.)

"WHEREAS, the members of the Florida State Horticultural Society are vitally interested in the welfare of the citrus industry, many of them directly, by reason of their grove holdings, and others indirectly, by reason of the importance of the industry in the development and prosperity of Florida, and

"WHEREAS, in the raising of funds for the eradication of citrus canker by public subscription, in the work of securing the enactment by the Florida Legislature of the law creating a State Plant Board and the measure appropriating $125,000.00 for the fight on citrus canker and in the campaign to secure aid from the Federal Government for the further prosecution of the canker eradication work, the members of this society have taken an active and influential part, and

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"WHEREAS, it is now certain, that no living man or group of men can accurately estimate the cost of carrying to a final conclusion this citrus canker eradication work or definitely determine the period of its duration and it is exceedingly probable that funds in addition to those now available will be required to complete the conquest of the disease, and

"WHEREAS, The State of Florida not only is required by the interests of her most important single industry to stand behind the fight on citrus canker until it has been entirely won, but also is under a moral obligation to do so in order to justify the Federal Government for the aid it has given and in extending further work as may be asked for, now therefore, be it

"RESOLVED, by the Florida State Horticultural Society in annual convention assembled at Arcadia on April 26th, 1916, that we regard it as incumbent on the next session of the State Legislature (provided citrus canker has not been eradicated) to appropriate such additional sums for citrus canker eradication as in the judgment of the State Plant Board may be necessary and we as individuals pledge ourselves to request from all candidates for members of the House of Representatives and State Senate in our respective counties and districts pledges to support such appropriations."

(Resolution seconded and adopted.)

RESOLUTIONS ADOPTED BY THE MEMBERS OF THE FLORIDA CITRUS SEMINAR AT GAINESVILLE, OCTOBER 18, 1916

"WHEREAS, the present annual State appropriation of $35,000.00 will not furnish sufficient funds to carry out the terms of the Plant Act, therefore, be it

"RESOLVED, that the Mass Meeting of citrus growers in attendance at the Citrus Seminar at Gainesville, assembled in annual session, recommend to the State Plant Board that in its estimate to be prepared for and presented to the next session of our State Legislature, they increase the amount estimated for the administration of the Plant Act to a sum sufficient to carry out the provisions of this law in a way that will fully protect the Agricultural and Horticultural interests of the State.

"WHEREAS, the members in attendance at the Florida Citrus Seminar are vitally interested in the welfare of the citrus industry, many of them directly, by reason of their grove holdings, and others indirectly, by reason of the importance of the industry in the development and prosperity of Florida, and

"WHEREAS, in the raising of funds for the eradication of citrus canker by public subscription, in the work of securing the enactment by the Florida Legislature of the law creating the State Plant Board and the measure appropriating $125,000.00 for the fight on citrus canker and in the campaign to secure aid from the Federal Government for the further prosecution of canker eradication work, the members in attendance at this Mass Meeting have always taken an active part and influential part, and

"WHEREAS, it is now certain that no living man or group of men can accurately estimate the cost of carrying to a successful conclusion this citrus canker eradication work or definitely determine the period of its duration and it is exceedingly probable that funds in addition to those now available will be required to complete the conquest of this disease, and

"WHEREAS, the State of Florida not only is required by the interests of her most important single industry to stand by the fight on citrus canker until it has been entirely won, but is also under moral obligation to do so in order to justify the Federal Government for the aid it has given and in extending further work as may be asked for, now therefore, be it

"RESOLVED, by the Mass Meeting of citrus growers in annual convention assembled at the Citrus Seminar at Gainesville on October 18th, 1916, that we regard it as incumbent on the next session of the State Legislature (provided citrus canker has not been eradicated) to appropriate such additional sums for citrus canker eradication as in the judgment of the State

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Plant Board may be necessary, and we as individuals pledge ourselves to request of all members of the House of Representatives and State Senate in our respective Counties and Districts pledges to support such appropriations."

THE QUARTERLY BULLETIN

As a means of placing in the hands of the farmers and fruit growers of the State information regarding various insects and diseases against which the Plant Board is directing measures of control or eradication, as well as for making available to the public the results of investigations being carried on, the Board authorized the publication of "The Quarterly Bulletin of the State Plant Board of Florida".

The first issue, Volume 1, No. 1, was published in October, 1916, and was devoted mainly to descriptions of citrus canker. A copy of this issue will be found in the appendix to this report. Application for entry of The Bulletin as second-class mail matter at the post office at Gainesville has been made and approved.

Inasmuch as the Plant Board cannot avail itself of any franking privilege for the distribution of its publications by mail the use of a regular publication, mailable at the second class rate of postage, appears to be the most practical and economical way of placing information in the hands of growers and other citizens directly interested in the Board's work.

EMPLOYEES

Owing to the magnitude of the tasks in which it is engaged, coupled with the active co-operation with the Bureau of Plant Industry in the eradication of citrus canker and with the Federal Horticultural Board in the inspection of plant importations, the Board necessarily has a large number of employees. Taking into consideration the fact that trained employees for such work as the Board is doing are not regularly available, in the sense that engineers, bookkeepers, chemists, physicians and the like are available for meeting emergencies, and the fact that the Board has itself had to train the great majority of its employees for their particular duties, it is remarkable that so efficient an organization has been gotten together in so short a time.

Space forbids a presentation of data showing the periods during which different employees have been engaged and as this information is available in the Plant Commissioner's office at

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Gainesville we give here the names of only such employees as were on duty at the close of the fiscal year.

Employees Whose Appointments Were Effective on April 30, 1916

Secretary's Office

Kellum, J. G., *Secretary*
Burch, F. A., *Assistant*

Plant Commissioner's Office

Newell, Wilmon, *Plant Commissioner*
Goodwin, J. C., *Chief Clerk*
Simmons, Mrs. L. A., *Stenographer*
Cornwell, Miss Madge E., *Stenographer*
Lampkin, Miss Isabel, *Stenographer*
Mabee, Miss Mildred, *Office Assistant*
Lloyd, Henry (col.), *Janitor*

Department of Citrus Canker Eradication*

(Plant Commissioner in Charge)
Stirling, Frank, *General Inspector*

District Inspectors

Clark, Virgil I.	Heck, Joy	Nieland, F. C.
Daniel, Leon A.	Henry, A. M.	Schlobig, John
Gist, J. V.	Horton, H. A.	Swanson, A. L.
Hainlin, Neal E.	Miller, J. A.	Wilson, G. H.

Assistant District Inspectors

Bollinger, Harry D.	Campbell, Matthew G.	Fletcher, J. M.
	Goldberg, Edward Robert	

Grove Supervisors

Bragdon, Kenneth E.	Chandler, A. L.	Grennell, Virgil M.
Montgomery, J. H.		Thompson, Alpheus A.

Foremen of Inspectors

Adams, Arthur	Gibson, Pearl B.	McClanahan, Samuel L.
Adams, Benj. Franklin	Gossman, Harvey L.	Mears, John M.
Albrecht, Chas. J.	Green, Joseph T.	Potter, Edwd. Raymond
Ayer, Aubrey E.	Higley, Albert W.	Raab, Albert G.
Barcus, George D.	Hobson, Robt. Leonard	Rahn, W. J.
Bateman. Raymond G.	Hoenshel, Paul M.	Reynolds, Roscoe
Burden, G. F.	Holcomb, James M.	Richmond, Leon C.
Carter, Howard G.	Holland, James S.	Rowe, William L.
Cash, Richard P.	Ingram, John W.	Schumacher, Henry E.
Chandler, Luther L.	Ingram, Otis D.	Sealey, John
Cox, Charles A.	Kelly, Emory L.	Sheffield, Chas. P.
Crum, Lemil Clarence	Kiner, James Otis	Smith, Cleve F.
Dillingham, H. J.	Laing, James David	Stone, O. T.
Dixon, C. D.	Liles, Fd.	Strain, John G.
Douglass, Elmer E.	Little, F. L.	Tedder, Geo. E.
Eikenberry, H. D.	Mahan, William D.	Wait, Stephen B.
Flowers. B. L.	Matthews, Stanley F.	Witt, Henry S.
Gaston, B. O.		Woodberry, Edw. R.

*As the work of this Department is conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, salaries of the employees, with the exception of the Plant Commissioner, are defrayed out of either State or Government funds, or both, as circumstances may require.

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INSPECTORS

Albrecht, Alfred C.
Baker, Willie O.
Bass, Clarence A.
Bass, Milledge M.
Black, Alvin L.
Blackburn, Grover C.
Bosse, Rufus F.
Boyett, Marshal M.
Browne, Clarence E.
Bynum, Eli K.
Chandler, Stewart C.
Chubb, Leland M.
Clark, Arthur J.
Clinger, John A.
Conner, Daniel S.
Crapo, David
Crum, Westley A.
Culley, Percy Edward
Curry, W. R.
Cutts, William H.
Daniel, Basil E.
Davis, Robert H.
Dixon, Albert LeRue
Dubbin, James McC.
Dunaway, Wilbur E.
Eberhardt, Walter F.
Edson, Perry M.
Eiland, John
Fish, Robert E.
Fitch, Samuel H.
Flora, Roy
Forbes, Walter R. T.
Ford, Arthur E.
Frierson, Hill H.
Fry, Benjamin B.
Fuchs, Fritz
Gaines, Geo. B. F.
Gearing, Jesse
Gench, Carl
Glegg, George
Graves, Thomas L.
Gwynn, Eddie L.
Hall, James E. B.
Harter, W. W.
Hatfield, Jeptha C.
Haywood, Frank E.
Hearn, Bryant Eugene
Henderson, Francis M.
Henderson, William H.
Hinson, Paul F.
Hoffman, Paul Frank
Holland, Chas. Hubert
Holland, Joseph W.
Hooker, Alphonse S.
Houston, Mills R.
Hunt, Chas. M.
Ingraham, Charles F.
Ishmael, Joseph L.
Jenness, Walter E.
Johnson, August P.
Kelley, Hugh L.
Kerr, James
Kinyoun, Gray
Kirkpatrick, Lawrence L.
Knighton, Harvey B.
Lasher, Abraham H.
Lasher, Leslie C.
Lazonby, J. Lionel
Lee, Dock
Lee, Henry C.
Lenz, Friedrich
LeRoy, Merton
Lindner, Ross W.
Linger, Russell B.
Little, Arnaud R.
Little, Leland S.
Lower, William D.
Ludlam, Joseph W.
Mahan, Charles R.
Marsh, Berry L.
McAllister, Alonzo O.
McCullough, James D.
McLendon, Albert S.
McLendon, John A.
Merrill, William H.
Millington, Wm. V.
Mills, Steve T.
Mongle, Thos. M.
Moore, Joseph W.
Moore, Jules B.
Murphy, Noah A.
Nanney, Wm. C.
Niedernhoefer, Wm. F.
Norwood, Jesse A.
Norwood, John N.
Nutting, Chas. T
Olinhant, Ross G.
O'Shields, Odom S.
Osteen, Ray J.
Owens, Thomas E.
Parham, Hosmer S.
Park, Bradley
Parker, Frank R.
Pemberton, Redden H.
Peters, Ralph
Putnal, Bonnie W.
Rawls, John C.
Reese, Mitchell A.
Reynolds, David N.
Roberts, Frank Arthur
Roberts, George L.
Roberts, Henry L.
Roberts, Leon F.
Roberts, Samuel F.
Robinson, Tom
Robinson, Vernon K.
Rodgers, Wm. B.
Ross, George N.
Ross, James Brown
Sadler, Ralph T.
Simmons, James R.
Simonds, Jay
Smith. Lonnie S.
Snell, Robert L.
Stephens, Charlie S.
Stephens, William L.
Stevens, R. C.
Stevenson, Asbary C.
Stokes, Clifford
Strong, C. E.
Sturrup, Eric G.
Swartsel, Howard B.
Thomas, William H.
Tobias, Benj. B.
Ulmer, Julius E.
Vaughan, James D.
Wade, George W.
Walker, George Samuel
Walton, William Karl
Wartmann, Henry A.
Wells, Benjamin B.
Wever, Ellison Capers
Wiley, Talmage M.
Wilson, James H.
Wilson, Joseph H.
Wood, Clarence O.
Yetter, Morris D.

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Department of Nursery Inspection

F. M. O'Byrne, *Nursery Inspector*, in Charge
Harn, S. P., *Assistant Nursery Inspector**
Zeluff, U. C., *Assistant Nursery Inspector*
Grimes, D. W., *Assistant Nursery Inspector*
Chaffin, J., *Assistant Nursery Inspector*
Bibby, F. F., *Assistant Nursery Inspector*
DaCosta, Miss Mary W., *Stenographer*
McIlvaine, Miss Lucretia, *Stenographer*

Packing-House Inspectors**

Alexander, G. T.
Baskin, J. D.
Bearss, W. O.
Campbell, W. P.
Childs, J. E.
Davis, L. L.
Francis, H. H.
Hinderliter, M. L.
Kime, C. D.
Lee, W. E.
LeGreid, W. C.
McCraney, D.
Meares, A. L.
Meares, George W.
Miller, H. A.
Morrow, A. G.
Stoltz, F. W.
Williams, Boyce

Department of Entomology

Dr. E. W. Berger, *Entomologist*, in Charge
Mason, A. C., *Assistant Entomologist*
Evans, Miss Ella M., *Stenographer*

Department of Port and Railway Inspection

(Plant Commissioner in Charge)
Hull, W. N., *Deputy Port and Railway Inspector**
Brown, A. C., *Deputy Port and Railway Inspector*
Gehry, Emil L., *Deputy Port and Railway Inspector*
Merrill, Geo. B., *Deputy Port and Railway Inspector*
Brown, Luther, *Deputy Port and Railway Inspector*

Department of Plant Pathology

(Plant Commissioner in Charge)
Jehle, Dr. R. A., *Assistant Plant Pathologist*

Employees Whose Appointments Were Effective on November 30, 1916

Secretary's Office

Kellum, J. G., *Secretary*
Burch, F. A., *Assistant*

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*As the inspection of citrus nurseries constitutes an important part in the eradication of citrus canker, salaries and expenses of assistant nursery inspectors assigned to the inspection of citrus nurseries are defrayed out of either Plant Board or Bureau of Plant Industry funds, or both, as circumstances may require.

** "Packing-house inspectors" are employed to supervise the fumigating, dipping, scrubbing or other precautionary treatments prescribed for nursery stock packed by certain nurseries, such as those occurring in cottony cushion-scale areas, etc., and are paid only for time actually employed. The wages of the packing-house inspectors are charged to the nurseries in which their work is performed. The Plant Board incurs no expense for their services.

*Deputy Port and Railway Inspectors of the State Plant Board are also Collaborators of the Federal Horticultural Board, U. S. Department of Agriculture, but as such receive only a nominal salary of $1.00 per month each. No other expense in connection with the port and railway inspection work in Florida is defrayed by the Federal Horticultural Board.

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Plant Commissioner's Office

Newell, Wilmon, *Plant Commissioner*
Goodwin, J. C., *Chief Clerk*
Simmons, Mrs. L. A., *Stenographer*
Cornwell, Miss Madge E., *Stenographer*
Lampkin, Miss Isabel, *Stenographer*
Carlisle, Mrs. Kathleen R., *Stenographer*
Colson, Mrs. K. D., *Stenographer*
Wallyn, Miss Evlyn, *Stenographer*
Mabee, Miss Mildred, *Office Assistant*
Lloyd, Henry (col.), *Janitor*

Department of Citrus Canker Eradication

(Plant Commissioner in Charge)
Stirling, Frank, *General Inspector*

District Inspectors

Campbell, Matthew G.
Clark, Virgil I.
Daniel, Leon A.
Gist, J. V.
Hainlin, Neal E.
Heck, Joy
Horton, H. A.
Mears, John M.
Miller, J. A.
Nieland, F. C.
Schlobig, John
Smith, Cleve F.
Swanson, A. L.
Wilson, G. H.

Assistant District Inspectors

Albrecht, Charles J.
Bass, Milledge M.
Bollinger, Harry D.
Carter, Howard G.
Fletcher, J. M.
Goldberg, Edward Robt.
Hoenshel, Paul M.
Potter, Edwd. Raymond
Tedder, George E.
Wartmann, Henry A.

Grove Supervisors

Bragdon, Kenneth E.
Grennell, Virgil M.
Montgomery, J. H.
Thompson, Alpheus A.

Foremen of Inspectors

Adams, Arthur
Adams, Benj. Franklin
Artis, Harvey C.
Baker, Thos. J.
Barber, Bascom D.
Barcus, George D.
Bateman, Raymond G.
Bearden, Cleveland C.
Browne, Clarence E.
Burden, G. F.
Cary, Chas. L.
Cash, Richard P.
Chandler, Luther L.
Cox, Charles A.
Crum, Lemil Clarence
Culley, Percy Edward
Dillingham, H. J.
Dixon, C. D.
Douglass, Elmer E.
Eikenberry, H. D.
Eiland, John
Flowers, B. L.
Ford, Arthur E.
Fuchs, Fritz
Gaines, Geo. B. F.
Gaston, B. O.
Gibson, Pearl B.
Gossman, Harvey L.
Graham, Erwin M.
Green, Joseph T.
Gwynn, Eddie L.
Harter, W. W.
Haywood, Frank E.
Henderson, Rufus C.
Henderson, William H.
Hobson, Robt. Leonard
Holcomb, James M.
Horton, Edward S.
Ingram, John W.
Ingram, Otis D.
Johnson, August P.
Kelly, Emory L.
Kerr, James
Laing, James David
Liles, Ed.
Lindner, Ross W.
Lower, William D.
Ludlam, Joseph W.
Mahan, William D.
McClanahan, Howard S.
McClanahan, Samuel L.
Mendel, James C.
Millington, Wm. V.
Nutting, Chas. T.
O'Neal, James R.
O'Shields, Odom S.
Parker, Frank R.
Raab, Albert G.
Rahn, Wm. J.
Reynolds, David N.
Reynolds, Roscoe
Richmond, Leon C.
Rogers, Frazier
Schumacher, Henry E.
Scott, William J.
Sheffield, Chas. P.
Sloan, Geo. D.
Stephens, William L.
Stone, O. T.
Strain, John G.
Swartsel, Howard B.
Thomas, William H.
Thompson, Troy
Vaughn, Mollov C.
Wade, George W.
Wait, Stephen B.
Warner, L. Russell
Williford, Talmage Y.
Witt, Henry S.

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INSPECTORS

Albrecht, Alfred C.
Alexander, David H.
Alexander, Guy T.
Baillie, Wm. J., Jr.
Baker, Byrd O.
Baker, George H.
Baker, J. Otis
Baker, L. J.
Baker, Willie O.
Ball, Joseph H.
Barnett, Harry B.
Bass, Clarence A.
Beaty, Alwyn L.
Benedict, William L.
Beville, Ulmont U.
Black, Alvin L.
Blackburn, Grover C.
Bosse, Rufus F.
Boyett, Marshal M.
Bradford, Horace
Branan, James Ruben
Brown, Charles M.
Brown, James B.
Brown, Merle R.
Brown, Ollie D.
Buchanan, Rex
Buff, William D.
Butts, John L.
Calcote, William H.
Camp, Paul Z.
Carpenter, Stanley D.
Cash, R. A.
Cellon, F. M.
Chamberlin, Harry T.
Church, Harry W.
Clark, Arthur J.
Clinger, John A.
Conner, Daniel S.
Craft, Fred L.
Crum, Westley A.
Curry, W. R.
Cutts, William H.
Daniel, Basil E.
Daughtrey, J. A., Jr.
Davis, Robert H.
Dickey, Edward K.
Dickson, Albert M.
Dobbin, James McC.
Donaldson, Wilson T.
Dukes, James R.
Dukes, Redding A.
Dunaway, Wilbur E.
Dyson, Zeblon V.
Eberhardt, Walter F.
Ellis, Thos. R.
Fish, Robert E.
Fitch, Samuel H.
Fogg, Harry W.
Forbes, Walter R. T.
Freeman, Jesse W.
Frierson, Hill H.
Frierson, Ed.
Fry, Benjamin B.
Fuller, Richard M.
Garcia, John R.
Gench, Carl
Grace, Don H.
Graves, Thomas L.
Gray, Charles F.
Hall, Clayton E.
Hall, James E. B.
Hammell, David L.
Hampson, Charles M.
Hansen, Hans W. A.
Harkins, D. L.
Harrison, Cyrus J.
Henderson, Francis M.
Henderson, J. Harvey
Hoffman, Paul Frank
Holland, Edward Alton
Holland, Joseph W.
Holton, John C.
Hood, Richard V.
Hooker, Alphonse S.
Howell, John F.
Hutchinson, D. O., Jr.
Ingraham, Charles F.
Irwin, Harry M.
Ishmael, Joseph L.
Jackson, Henry C.
Jackson, James
Janes, George
Jenness, Walter E.
Keller, P. C.
Kersey, Walter L.
Knight, Robert L.
Kinyoun, Gray
Lahrman, Walter O.
Lamb, Kirkland S.
Lasher, Abraham H.
Lasher, Leslie C.
Lawley, Harley H.
Lazonby, J. Lionel
Lee, Dock
Lee, Henry C.
Lee, Lewis M.
Lee, Russell E.
Lenz, Friedrich
LeRoy, Merton
Levis, Norris K.
Light, L. S., Jr.
Lindley, Kingston H.
Little, Arnaud R.
Mahan, Charles R.
Maloney, Clarence B.
Marsh, Berry L.
Marsh, James F.
Marshall, Galen G.
Martin, Clarence W.
McAllister, Alonzo O.
McCullough, James D.
McKay, Haden M.
McLendon, John A.
McMullen, Henry L.
Melendy, B. E.
Melton, Wilburn P.
Merrill, William H.
Miller, Herbert L.
Moore, John L.
Moore, Joseph W.
Moore, Jules B.
Morgan, James Raiford
Mowry, Harold
Neal, Cecil G.
Niedernhoefer, Wm. F.
Nixon, Roy R.
Norwood, Jesse A.
Noxtine, H. A.
Oakley, Archie R.
Oliphant, Ross G.
Parham, Harry C
Park, Bradley
Pemberton, Henry F.
Pemberton, Redden H.
Pinelli, Joe
Poos, Fred W., Jr.
Potter, Roscoe D.
Pryor, T. J.
Putnal, Bonnie W.
Rawls, Axon Badger
Reese, Mitchell A.
Roberts, Frank Arthur
Roberts, Geo. L.
Roberts, Samuel F.
Robertson, Paul F.
Robinson, Tom
Robinson, Vernon K.
Rodgers, William B.
Ross, George N.
Ross, James Brown
Royal, John W.
Rudesill, Dick
Salls, Kenneth T.
Scudder, Hamilton F.
Sealey, John
Seeds, Harvey W.
Seitz, Harry G.
Shelton, J. L.
Sherman, Charles D.
Sherouse, Dave T.
Shriner, Ike M.
Simmons, James R.
Simonds, Jay
Smith, Clyde
Smith, Herman D.
Smith, Joseph G.
Smith, Lawrence O.
Smith, Lonnie S.
Spiller, William A.
Steil, Fred H.
Stephens, Charlie S.
Stevens, R. C.
Stevenson, Asbary C.

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INSPECTORS (Continued)

Stevenson, Elbert M.
Stevenson, George A.
Stevenson, Richard D.
Stokes, Clifford
Strong, C. E.
Swann, Porter R.
Taylor, Jesse F.
Thomas, Paul
Thompson, Roy
Thomson, James
Tryon, Harry D.
Ulmer, Julius E.
Ulmer, Robert L.
Vaughan, James D.
Vetter, Paul
Vincent, Clarence A.
Walker, George Samuel
Walker, Shirley B.
Wells, Benjamin B.
Wells, Paul L.
Wever, Ellison Capers
Whidden, Marion T.
Whitehurst, Andrew A.
Whitehurst, Linton L.
Whittington, C. E.
Wilder, H. S.
Wilson, James H.
Wilson, Joseph H.
Wood, Clarence O.
Woodruff, Seth L.

Department of Nursery Inspection

F. M. O'Byrne, *Nursery Inspector*, in Charge
Harn, S. P., *Assistant Nursery Inspector*
Zeluff, U. C., *Assistant Nursery Inspector*
Chandler, Stewart C., *Assistant Nursery Inspector*
Bibby, F. F., *Assistant Nursery Inspector*
Nanney, W. C., *Assistant Nursery Inspector*
Roberts, Leon F., *Assistant Nursery Inspector*
Bynum, Eli K., *Assistant Nursery Inspector*
Wilson, C. E., *Assistant Nursery Inspector*
Kirkpatrick, L. L., *Assistant Nursery Inspector*
Hunt, Chas. M., *Assistant Nursery Inspector*
Carothers, A. B., *Assistant Nursery Inspector*
Linger, R. B., *Assistant Nursery Inspector*
DaCosta, Miss Mary W., *Stenographer*
McIlvaine, Miss Lucretia, *Stenographer*

Packing-House Inspectors

Aligood, C. E.
Bearss, W. O.
Block, W. C.
Bruyiere, J.
Campbell, W. P.
Conrad, Chas. A.
DeLanoy, S. S.
Dougherty, Lynn
English, B. S.
Francis, H. H.
Gantt, J. E.
Jenner, J. T.
Keller, Wm.
Kime, C. D.
Lee, W. E.
Luce, D. H.
McCollom, J. A.
McCraney, D.
Millen, S. E.
Miller, H. A.
Oesterle, Chas.
Parker, P. C.
Pylant, S. L.
Rogers, O. H.
Roper, B. H.
Sadler, F. W.
Scorgie, L. A.
Smith, L. W.
Stewart, J. L.
Stoltz, F. W.
Summerall, Perry
Tate, L. Z.
Townsend, L. N.
Tullbery, C. C.
Williams, Boyce
Wright, W. W.

Department of Entomology

Dr. E. W. Berger, *Entomologist*, in Charge
Mason, A. C., *Assistant Entomologist*
Evans, Miss Ella M., *Stenographer*

Department of Port and Railway Inspection

(Plant Commissioner in Charge)
Hull, W. N., *Deputy Port and Railway Inspector*
Brown, A. C., *Deputy Port and Railway Inspector*
Gehry, Emil L., *Deputy Port and Railway Inspector*
Merrill, George B., *Deputy Port and Railway Inspector*
Brown, Luther, *Deputy Port and Railway Inspector*
Grimes, D. W., *Deputy Port and Railway Inspector*
Staples, I., *Deputy Inspector*
Mitchell, Joseph, *Deputy Inspector*

Department of Plant Pathology

(Plant Commissioner in Charge)
Jehle, Dr. R. A., *Assistant Plant Pathologist*
McKay, Haden M., *Temporary Assistant*

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FINANCIAL REPORT

The following report on the finances of the Board is submitted by Mr. J. G. Kellum, Secretary:

"TALLAHASSEE, FLA., Sept. 30, 1916.

State Plant Board.

GENTLEMEN:—I have the honor to submit the following report of the finances of the Board for the period beginning May 1st, 1915, and ending Sept. 30th, 1916.

SUMMARY

Resources

General Appropriation for year ending April 30, 1916	$35,000.00	
General Appropriation for year ending April 30, 1917	35,000.00	
Special Appropriation for the Eradication of Citrus Canker	125,000.00	
Donations and Incidental Collections	5,369.27	
Total		$200,369.27

Expenditures

For Salaries	$116,236.96	
For Office Supplies	7,427.74	
For Traveling Expenses	20,718.60	
For Printing Bulletins, etc.	2,241.24	
For General Supplies	11,662.05	
For Miscellaneous Expenses	2,513.56	
Unexpended part of Appropriation for year ending April 30, 1916	.18	
Total Expenditures		$160,800.33
Balance September 30, 1916		$ 39,568.94"

ITEMIZED EXPENDITURES

Resources. Special Fund

Appropriation	$125,000.00

Expenditures

For Salaries	$ 88,232.41	
For Office Supplies	323.63	
For Traveling Expenses	14,498.97	
For Printing Bulletins	34.00	
For General Supplies	6,274.81	
For Miscellaneous Expenses	1,684.57	
Total Expenditures		111,048.39*
Balance Unexpended September 30, 1916		$ 13,951.61

*Does not include expenses incurred during September, 1916, vouchers for which were approved at the October Board meeting.

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DONATIONS AND INCIDENTAL COLLECTIONS

Resources

Total Receipts from May 1, 1915, to September 1, 1916	$ 5,369.27

Expenditures

For Salaries	$ 1,645.50	
For Traveling Expenses	75.56	
For Printing	1.95	
For General Supplies	1,530.75	
Total Expenditures to September 30, 1916		3,253.76
Balance on Hand September 30, 1916		$ 2,115.51 "

GENERAL FUND

For Year Ending April 30th, 1916

Resources

Appropriation	$ 35,000.00

Expenditures by Items

For Salaries	$ 18,014.74	
For Office Supplies	6,596.47	
For Traveling Expenses	5,122.07	
For Printing Bulletins	1,527.09	
For General Supplies	3,131.75	
For Miscellaneous Expenses	607.70	
Balance Unexpended for Expenses of Year	.18	
Total		$ 35,000.00 "*

For Year Ending April 30th, 1917

Resources

Appropriation	$ 35,000.00

*The disbursement of the General Fund during the fiscal year ending April 30, 1916, classified by departments rather than by items, was as follows:

Plant Board, Expenses	$ 298.97
Advisory Committee, Expenses	794.55
Secretary's Office (Tallahassee)	1,310.74
Plant Commissioner's Office (Gainesville)	13,601.12
Department of Entomology	4,573.50
Department of Nursery Inspection	10,793.17
Department of Plant Pathology	2,189.42
Department of Port and Railway Inspection	1,438.35
Unexpended balance reverting	.18
Total	$35,000.00

—Plant Commissioner.

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Expenditures

For Salaries	$ 8,344.31	
For Office Expenses	507.64	
For Traveling Expenses	1,022.00	
For Printing Bulletins	678.20	
For General Supplies	724.74	
For Miscellaneous Expenses	221.29	
Total Expenses to September 30, 1916		11,498.18**
Balance Unexpended		$ 23,501.82

Respectfully submitted,

J. G. KELLUM, Secretary."

ESTIMATES

The following estimates on the appropriation required for the general work of the Plant Board during each of the ensuing fiscal years are based upon furnishing the farmers and fruit growers of the State with that protection against injurious insects and diseases contemplated by the Florida Plant Act of 1915 and which means to them countless thousands of dollars saved from the ravages of these pests, as well as thousands more from pests which are certain to enter Florida from other States and countries should this protection not be afforded.

The continuing appropriation of $35,000.00 per annum, made by the last Legislature for carrying out the general provisions of the Plant Act, has been found totally inadequate for the purpose. The reason for this lies largely in the fact that the doors of Florida were wide open for years, with no protection being afforded its agricultural industries, with the result that the agricultural pests already introduced into the State annually levy a toll of from 15 to 25 per cent on the general farm crops and from 40 to 60 per cent on the fruit and truck crops.

Unfortunately practically all supplies used by the Plant Board in its work, such as paper, stationery, laboratory equipment, chemicals, disinfectants, etc., have greatly advanced in price

**The disbursement of this item, by departments, was as follows:

Plant Board, Expenses	$ 0.00
Advisory Committee, Expenses	56.60
Secretary's Office	412.45
Plant Commissioner's Office	4,222.69
Department of Entomology	1,427.47
Department of Nursery Inspection	2,277.26
Department of Plant Pathology	521.48
Department of Port and Railway Inspection	2,580.23
Total, May 1, to Sept. 30, 1916	$11,498.18

—Plant Commissioner.

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since the appropriation was made. The rapid upward tendency of salaries being paid by commercial organizations has also made it extremely difficult, and in many cases impossible, for the Plant Board to retain efficient employees at the salaries which its resources permit it to pay. Despite the increased cost of supplies and of services the following estimates are based upon actual experience during the past 18 months.

GENERAL FUND

Estimated Expenses Per Annum

PLANT BOARD

Traveling Expenses of Board Members	$ 300.00	
Postage and Telegrams, Board Members	50.00	
Total		$ 350.00

SECRETARY'S OFFICE

Salary of Secretary	$ 600.00	
Salary of Assistant Secretary	600.00	
Postage and Stationery	100.00	
Total		1,300.00

PLANT COMMISSIONER'S OFFICE

Salaries:		
Plant Commissioner	$ 4,000.00	
1 Chief Clerk	1,500.00	
1 Filing Clerk at $60.00 per month	720.00	
2 Stenographers at $75.00 per month, each	1,800.00	
2 Stenographers at $70.00 per month, each	1,680.00	
1 Janitor at $30.00 per month	360.00	
Total, Salaries		$ 10,060.00
Traveling Expenses, Plant Commissioner	$ 450.00	
Postage and Stamped Envelopes	1,050.00	
Telephone and Telegrams	108.00	
Letterheads, Plain White Paper, Envelopes, etc	165.00	
Office Desks, Tables and Chairs	115.00	
Filing Furniture	140.00	
Filing Folders, Guide and Record Cards, Blank Books, etc.	180.00	
Typewriters and Typewriter Maintenance	325.00	
Repairs and Maintenance of Rooms Occupied at University of Florida, and Equipment of Storerooms and Laboratory in Attic of Language Hall	75.00	
Express, Drayage and Freight	140.00	
Multigraph Supplies and Maintenance	185.00	
Publication of Quarterly Bulletin,* 4 Issues, 20,000 Copies Per Issue, at $800.00 Per Issue	3,200.00	
Postage on Quarterly Bulletin at Second-Class Rate, 4 Issues at $18.00 Per Issue	72.00	

*In lieu of all other expenses for publishing bulletins, except rules of the Board as adopted, and official notices to transportation companies.

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Publication of Plant Board "Circulars" Containing Rules, Regulations and Public Notices of the Board as Adopted, 12 Issues, 5,000 Copies Each, at $26.00 Per Issue	312.00	
1 Addressing Machine and Accessories	1,080.00	
Electricity,** 12 Months, at $5.00 Per Month	60.00	
Heat,** 4 Months, at $9.00 Per Month	36.00	
Reference Books and Agricultural and Technical Publications***	260.00	
		7,953.00
Total, Plant Commissioner's Office		$ 18,013.00

Department of Nursery Inspection

Salaries:		
Nursery Inspector (Chief of the Department)	$ 2,250.00	
12 Assistant Inspectors at $1,200.00	14,400.00	
2 Stenographers at $75.00 Per Month	1,800.00	
1 Stenographer at $70.00 Per Month	840.00	
Total, Salaries		$ 19,290.00
Traveling Expenses:		
Nursery Inspector	$ 375.00	
12 Assistant Inspectors at $60 Per Month Average	8,640.00	
Postage	720.00	
Stationery	145.00	
Telegrams	90.00	
Typewriters, Maintenance, Office Furniture, Filing Material and Record Blanks	325.00	
		10,295.00
Total, Department of Nursery Inspection		$ 29,585.00

Department of Port and Railway Inspection

Salaries:		
Port and Railway Inspector (Chief of the Department)	$ 2,000.00	
4 Deputy Inspectors at $1,500.00	6,000.00	
2 Deputy Inspectors at $1,200.00	2,400.00	
1 Deputy Inspector at $ 600.00	600.00	
2 Deputy Inspectors at $ 240.00	480.00	
1 Stenographer at $900.00	900.00	
Total, Salaries		$ 12,380.00
Traveling Expenses:		
Port and Railway Inspector	$ 750.00	
3 Deputy Inspectors at $600.00	1,800.00	
Postage	150.00	
Telegrams	40.00	
Stationery	65.00	
Port Expenses (Boat Hire, Street Car Fare, Quarantine Tags, Labor, etc.)	250.00	

**Payable to the University of Florida.

***The Plant Board funds have not heretofore permitted of the purchase of reference works, which are urgently needed.

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Publication of "Port and Railway Inspection Notices," Estimated 5 Issues, of 5,000 Copies Each, at $21.50 Per Issue	107.50	
Express, Drayage and Freight	25.00	
		3,187.50
Total, Department of Port and Railway Inspection		$ 15,567.50

PARCELS-POST PLANT INSPECTION*

Salary, 1 Deputy Inspector	$ 1,200.00	
Disinfectants, Fumigating Boxes, Tags, etc.	400.00	
Drayage on Parcel Post Packages for Inspection, Between Post Office and University at Gainesville, at $15.00 Per Month	180.00	
Total, Parcels-Post Plant Inspection		$ 1,780.00

DEPARTMENT OF ENTOMOLOGY

Salaries:		
Entomologist (Chief of the Department)	$ 2,500.00	
1 Assistant Entomologist	1,200.00	
Labor	220.00	
		$ 3,920.00
Traveling Expenses:		
Entomologist	$ 400.00	
Assistant Entomologist	350.00	
		750.00
Postage	$ 310.00	
Laboratory Supplies	460.00	
Express, Freight and Drayage	95.00	
Reference Books	160.00	
Furniture	200.00	
Special Laboratory Equipment (Benches, Pots, Tubs, etc.)	85.00	
Observation Cages for Life History Work	150.00	
Photographic Supplies	130.00	
Insect Cases, Labels and Record Files	110.00	
Chemical and Laboratory Reagents	50.00	
		1,750.00
Total, Department of Entomology		$ 6,420.00

DEPARTMENT OF PLANT PATHOLOGY

Salaries:		
Plant Pathologist (Chief of Department)	$ 3,000.00	
1 Assistant Plant Pathologist	2,500.00	
		$ 5,500.00
Traveling Expenses:		
Plant Pathologist	$ 550.00	
Assistant Plant Pathologist	240.00	

*Under an order issued by the Third Assistant Postmaster-General on October 24, 1916, all mail shipments of plants and plant products addressed for delivery at Florida post offices are required sent to Gainesville for inspection by the State Plant Board.

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Equipment of Laboratory at Gainesville	900.00	
Postage	125.00	
Stationery	60.00	
Reference Books and Publications	110.00	
Photographic Equipment (Camera, Lenses, etc.)	140.00	
Photographic Plates, Paper and Chemicals	35.00	
		2,160.00

Tropical Laboratory, Redland, Dade County

Renewal of Glassware, Apparatus, etc.	$ 125.00	
1 Typewriter	100.00	
Gasoline for Gas Plant	80.00	
Freight and Drayage	60.00	
Reference Books	30.00	
Repairs, Laboratory Building and Outdoor Equipment	30.00	
Trees and Plants for Use in Experiments	40.00	
		465.00
Total, Department of Plant Pathology		$ 8,125.00

SUMMARY

Plant Board Expenses	$ 350.00	
Secretary's Office	1,300.00	
Plant Commissioner's Office	18,013.00	
Department of Nursery Inspection	29,585.00	
Department of Port and Railway Inspection	15,567.50	
Parcels-Post Plant Inspection	1,780.00	
Department of Entomology	6,420.00	
Department of Plant Pathology	8,125.00	
Grand Total, General Fund Per Annum		$ 81,140.50

CITRUS CANKER ERADICATION

The actual cost of conducting the canker eradication work in Florida from May 1 to September 30, 1916, five months, was $179,671.51*, or $35,934.30 per month. This was at the rate of $431,211.60 per annum, but despite the practice of every possible economy that could be devised the number of men em-

*This amount was expended as follows:

	Out of Plant Act Special Fund			Out of Federal Appropriations, by Bureau of Plant Industry			
Month 1916	Salaries	Trav. Expense	Supplies	Salaries	Trav. Expenses	Supplies	Total for Month
May	$ 35.00	$248.09	$183.99	$19,281.05	$4,902.68	$1,290.07	$25,940.88
June	155.55	555.12	278.98	24,174.96	6,587.62	1,470.74	33,222.97
July	102.50	141.48	73.99	27,107.05	8,478.96	1,616.83	37,520.81
August	101.67	42.72	137.25	27,852.45	8,686.97	3,919.60	40,740.66
September	260.33	71.56	95.99	27,919.88	9,517.53	4,380.90	42,246.19
Grand Total							$179,671.51

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ployed was not sufficient to secure the maximum efficiency and speed in stamping out the various outbreaks. It is a certainty that it will require a continuation of this work on at least as extensive a scale as at present for two and one-half years to come. Assuming that the Bureau of Plant Industry, United States Department of Agriculture, will provide for the continuation of this work from the time of this report until April 30, 1917, it is seen that sufficient funds for continuing the inspection and eradication work for two years from the latter date must be available. Based upon the actual cost of conducting this work during 1916 and without anticipating any unusual developments or emergencies, the sum of $431,200.00 per annum, or $862,400.00 for the two-year period, will be required. Assuming, again, that the Federal Government will co-operate to the extent of paying one-half the cost of the eradication work during the two-year period, through appropriations made by Congress, a minimum of $431,200.00 must be made available from other sources.

I therefore recommend that your honorable Board present to His Excellency, the Governor of Florida, and to the members of the Legislature, the advisability of appropriating not less than $431,200.00 as a special fund with which to continue the work of eradicating citrus canker.

GRAND SUMMARY OF FUNDS REQUIRED

General Fund, Fiscal Year ending April 30, 1918.....	$ 81,140.50
General Fund, Fiscal Year ending April 30, 1919.....	81,140.50
Special Fund for the Eradication of Citrus Canker..	431,200.00
Grand Total	$593,481.00

Respectfully submitted,

WILMON NEWELL,
Plant Commissioner.

Gainesville, Fla.,
November 30, 1916.

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DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING MARCH 31, 1917

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending March 31st, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING MARCH 31, 1917

Citrus grove trees inspected	3,451,027
Citrus nursery trees inspected	15,771,754
Inspectors employed	378
New properties showing infection	2
Total properties showing active infection	16
Grove trees found infected	27
Nursery trees found infected	7
Counties in which active infections were found	5

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,363
Nursery trees found infected since May, 1914	342,228
Number properties infected to March 31, 1917	443
Properties declared no longer "danger centers"	306
Properties still classed as "infected", March 31, 1917	137

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1917:

1914		1915		1916		1917	
		January	306	January	86	January	14
		February	165	February	21	February	4
		March	444	March	49	March	9
		April	408	April	49		
May	108	May	1042	May	338		
June	160	June	772	June	450		
July	275	July	651	July	349		
August	1313	August	1345	August	219		
September	767	September	618	September	124		
October	565	October	214	October	451		
November	773	November	494	November	131		
December	366	December	256	December	27		

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DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING MARCH 31, 1917

The following report on the inspection of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

SHIPS AND VESSELS INSPECTED:

From foreign ports	376	
From U. S. ports other than Florida	231	
From Florida ports	593	
Total		1200

SHIPMENTS INSPECTED:

Arriving by water:		
Passed	45	
Treated and passed	11	
Returned to shipper	54	
Detained, subject to return	3	
Contraband destroyed	523	
		636
Arriving by express, freight, etc.:		
Passed	273	
Treated and passed	34	
Returned to shipper	15	
Detained, subject to return	51	
Contraband destroyed	39	
		412
Total shipments inspected		1048

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of shipments infested
Cactus scale	Cactus	Florida	1
California black scale	Hibiscus	Florida	1
California red scale	Oleander	Florida	1
Camphor thrips	Camphor	Florida	1
Chaff scale	Palm	Georgia	1
Cottony cushion-scale	Croton	Florida	1
Cottony cushion-scale	Croton	Cuba	2
Cottony cushion-scale	Avocado	Cuba	1
Cottony cushion-scale	Rose	Jamaica	1
Crown gall	Rose	South Carolina	1
Crown gall	Grape	Florida	1
Crown gall	Peach	Georgia	1
Dictyospermum scale	Citrus	Spain	1
Florida wax-scale	Pear	Florida	1
Florida red scale	Citrus	Florida	2
Fern scale	Fern	Georgia	1
Mealy-bug	Citrus	Florida	1
Melanose	Citrus	Florida	1
Mango scale	Mango	Florida	1
Nematode root-knot	Apple	North Carolina	1
Nematode root-knot	Cherry	Georgia	1
Nematode root-knot	Fig	Florida	5

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Insect or Disease	Occurring on	From	Number of shipments infested
Nematode root-knot	Fig	Georgia	7
Nematode root-knot	Fig	South Carolina	7
Nematode root-knot	Fig	Texas	1
Nematode root-knot	Grape	Georgia	1
Nematode root-knot	Mulberry	Florida	2
Nematode root-knot	Papaya	Florida	1
Nematode root-knot	Peach	Florida	2
Nematode root-knot	Peach	Georgia	4
Nematode root-knot	Peach	South Carolina	1
Nematode root-knot	Plum	Florida	1
Nematode root-knot	Plumbago	Florida	2
Nematode root-knot	Rose	South Carolina	1
Rufous scale	Tamarind	Cuba	1
Rufous scale	Unknown plant	Cuba	1
Red spider	Rose	Cuba	2
Peach-borer	Plum	South Carolina	1
Purple scale	Citrus	Florida	4
Papaya fruit-fly	Papaya	Cuba	1
Papaya fruit-fly	Papaya	Florida	3
Peach scale	Peach	Florida	1
San Jose scale	Apple	Georgia	1
San Jose scale	Apple	North Carolina	1
San Jose scale	Cherry	Kentucky	1
San Jose scale	Cherry	South Carolina	1
San Jose scale	*Crategus* sp	North Carolina	1
San Jose scale	Mulberry	Florida	1
San Jose scale	Peach	Florida	2
San Jose scale	Peach	Georgia	5
San Jose scale	Peach	Illinois	2
San Jose scale	Peach	South Carolina	1
San Jose scale	Pear	Florida	1
San Jose scale	Plum	Florida	2
San Jose scale	Plum	Georgia	1
San Jose scale	Poplar	Georgia	1
Sugar-cane borer	Sugar-cane	Cuba	2
Whitefly	Avocado	Florida	1
Whitefly	Citrus	Florida	4

PARCEL POST PLANT INSPECTION

Under an Order issued by the Third Assistant Postmaster General, October 24, 1916, mail shipments of plants and plant products addressed for delivery at Florida postoffices are required sent to Gainesville for inspection by the State Plant Board. Inspection under this Order was commenced at the Gainesville postoffice November 4, 1916. Full details concerning this Order and the Act of Congress under authority of which it was issued will be found on page 154 of this issue.

NOVEMBER 4 TO DECEMBER 31, 1916

PARCELS INSPECTED:

Passed	165	
Treated and passed	6	
Returned to sender	0	
Detained, subject to return	1	
Infested or infected parcels destroyed	0	
Total Parcels Inspected		172

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Pests and Diseases Intercepted

Pest	Occurring on	From	Number of parcels infested
Florida red scale	Citrus	Florida	1
Long scale	Citrus	Florida	1
Purple scale	Citrus	Florida	2
Nematode root-knot	Fig	Florida	1

Quarter Ending March 31, 1917

Parcels Inspected:

Passed	2294	
Treated and passed	80	
Returned to sender	551	
Detained, subject to return	12	
Infested or infected parcels destroyed	3	
Total Parcels Inspected		2890

Pests and Diseases Intercepted

Pest	Occurring on	From	Number of parcels infested
Borer	Walnut	Georgia	1
Peach-borer	Plum	Mississippi	1
Chaff scale	Citrus	Ohio	1
Crown gall	Rose	Ohio	15
Dictyospermum scale	Rubber	Ohio	1
Melanose	Citrus	Florida	1
Purple scale	Citrus	Florida	3
Nematode root-knot	Begonia	Ohio	10
Nematode root-knot	*Cissus discolora*	Ohio	1
Nematode root-knot	Coleus	Ohio	2
Nematode root-knot	Chrysanthemum	Ohio	15
Nematode root-knot	Cyclemen	Ohio	1
Nematode root-knot	Daisy	Ohio	16
Nematode root-knot	Fig	Florida	2
Nematode root-knot	Geranium	Ohio	18
Nematode root-knot	Hibiscus	Ohio	17
Nematode root-knot	Honeysuckle	Ohio	3
Nematode root-knot	Ivy	Ohio	1
Nematode root-knot	Lemon verbena	Ohio	2
Nematode root-knot	*Primula obconica*	Ohio	1
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Peony	Ohio	1
Nematode root-knot	Rose	Florida	1
Nematode root-knot	Rose	Ohio	481
Nematode root-knot	Rose	Pennsylvania	1
Nematode root-knot	Rose	North Carolina	1
Nematode root-knot	Salvia	Ohio	1
Nematode root-knot	Tomato	Florida	1
Nematode root-knot	Violet	Ohio	1
Nematode root-knot	Wistaria	Ohio	1
San Jose scale	Rose	Florida	1
Whitefly	Citrus	Florida	2
Whitefly	Citrus	Ohio	1

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner* ..... *Editor*

ASSOCIATE EDITORS.

E. W. BERGER ..... *Entomologist*
F. M. O'BYRNE ..... *Nursery Inspector*
R. A. JEHLE ..... *Asst. Plant Pathologist*
FRANK STIRLING ..... *General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

CRISES IN THE CANKER ERADICATION WORK. On more than one occasion situations have arisen which have threatened the success of the eradication work but always ingenuity, hard work and quick adaptation to changing conditions have saved the day. Such a crisis presented itself in the early summer of 1915, when the number of canker-infected trees found in Dade County steadily increased each week. The Plant Board had to decide whether it would discontinue the fight in Dade County in order to cope with the disease in the balance of the State, before its funds became exhausted, or to continue the Dade County campaign with all available resources until the last moment. The latter policy was adopted and proved to be the correct one, for shortly afterwards the effectiveness of the work was shown by a falling off in the number of infections.

Between February 2 and 10, 1917, a severe cold spell visited Florida, amounting in some sections to a freeze of intensity, defoliating all citrus trees and in some cases killing young trees to the ground. Nothing of the kind had occurred since the beginning of canker eradication work. Inspection of the usual type, with all foliage killed, was of course impossible. Even before the cold weather moderated instructions went out to the District Inspectors calling for a thorough "cleaning up" in canker-infected properties. Fallen leaves were gathered up and burned and leaves remaining on the smaller trees were removed by hand and destroyed. Twigs and limbs injured by the cold were pruned out by the inspectors, the wounds disinfected

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and the surfaces of the trees disinfected by spraying with a weak solution of formaldehyde. The lowest temperature reached was not low enough to kill citrus canker bacteria and it was hoped, by these "sanitary" measures, to dispose of any dormant infections which may have existed in the dead and fallen leaves or in the pruned-out wood. It is too early yet to determine the results of this work but those in charge feel that the adaptation of methods to the new conditions have at least resulted in no ground being lost in the fight against canker. With the appearance of the new spring growth inspection work was resumed in the usual manner.

While this was going on another difficulty appeared. The Federal appropriation of a year ago was practically exhausted and word came from Washington to cut the canker eradication expenditures in Florida, for February, by more than $10,000. This emergency was promptly met by the inspectors themselves, many of whom made actual donations of the expenses incurred, while others voluntarily "laid off" in order to reduce the payroll. Twenty inspectors donated the use of their personally-owned automobiles. The use of these cars, reckoned at $1.50 per day per auto, amounted to $596.00. Traveling and other expenses defrayed by the inspectors during February amounted to $3,617.03 more. On February 28th orders came from Washington to discontinue all work as the appropriation was exhausted and Congress had not yet passed the Agricultural Bill providing new funds. For once the inspectors did not obey orders, for over two hundred of them continued their work, knowing full well they would receive no compensation. The time donated by the inspectors between March 1st and 4th amounted to $1,027.57. Expenses of eradication work personally defrayed by the men amounted to $237.62, while automobile usage was again donated to the value of $71.34, making a total of $5,549.56 in time and cash contributed by employees of the Plant Board and Bureau of Plant Industry between February 1st and March 4th.* As a result of these donations, together with payment of part of the February expenses by the State Plant Board, the canker eradication work was carried through without serious interruption or grave risk being incurred.

One would seek far to find an organization of men so devoted and loyal to a public cause.

* The Agricultural Bill, making $180,000 available for canker eradication in the South, was passed by Congress on March 4th, one hour before adjournment, and was signed by President Wilson the same day.

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RULES AND REGULATIONS MADE BY THE STATE PLANT BOARD PURSUANT TO THE FLORIDA PLANT ACT OF 1915, UP TO AND INCLUDING APRIL 9, 1917

PUBLIC NOTICE

Declaring Certain Insects and Diseases to Be Public Nuisances

*Under the provisions of the Florida Plant Act of 1915, Chapter 6885, approved April 30, 1915, the State Plant Board of Florida, in accordance with Section 5 of said Act, does declare the following insects and diseases, and each and every plant and thing infested or infected therewith, to be public nuisances:

Insect or Disease	Plants Likely to Become Infested or Infected
Avocado Weevil (*Heilipus lauri* Boh.).	Avocado.
Banana Root Borer (*Sphenophorus (Cosmopolites) sordidus* Germar).	Banana. Sugar cane.
Banana Wilt Disease, or "Panama Disease" (*Fusarium* sp.).	Banana.
Brown Rot (*Pythiacystis citrophora*).	Lemons. Oranges. Apple (*Pyrus malus*)†. Apple, crab (*Pyrus coronaria*). Apricot (*Prunus armeniaca*). Ash, Black (*Fraxinus nigra*). Ash, Blue (*Fraxinus quadrangulata*). Ash, Red (*Fraxinus pennsylvanica*). Ash, White (*Fraxinus americana*). Barberry (*Berberia vulgaris*). Basswood (*Tilia americana*). Beach Plum (*Prunus maritima*). Beech, American (*Fagus grandifolia*). Birch, Black. Birch, Gray. Birch, Paper. Birch, Yellow. Blackberry (*Rubus villosus*). Box-elder (*Acer negundo*). Cherry (*Prunus avium*). Cherry, wild black (*Prunus serotina*). Chestnut (*Castanea dentata*). Chokeberry (*Aronia melanocarpa*). Choke Cherry (*Padus nana*). Crataegus, all species. Creeper, Virginia (*Ampelopsis quinquefolia*). Currant (*Ribes rubrum*). Elm, American (*Ulmus americana*). Elm, Cork Elm, English Elm, Scotch Elm, Slippery. Gooseberry (*Ribes grossularia*). Grape (*Vitis cordifolia*). Hophornbeam (*Ostrya virginica*).
(*Euproctis chrysorrhaea* Linn).	

*Adopted May 4, 1915. Amended Feb. 14, 1916, June 5, 1916, Aug. 14, 1916, and Jan. 8, 1917.

†List from data furnished by the Bureau of Entomology, U. S. D. A.

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Insect or Disease	Plants Likely to Become Infested or Infected
	Hornbeam *(Carpinus caroliniana)*.
	Maple, Cut-leafed.
	Maple, Red.
	Maple, sugar *(Acer saccharinum)*.
	Maple, sycamore *(Acer pseudo-platanus)*.
	Maple, white *(Acer dasycarpum)*.
	Oaks *(Quercus* sp.*)*.
	Peach *(Prunus persica)*.
	Pear *(Pyrus communis)*.
	Plum *(Prunus domestica)*.
	Pyrus pinnatifida.
	Quince *(Cydonia vulgaris)*.
	Quince, Japan *(Cydonia japonica)*.
	Raspberry *(Rubus strigosus)*.
	Rose *(Rosa nitida)*.
	Shadbush *(Amelanchier canadensis)*.
	Spiraea *(Spiraea thunbergii)*.
	Sumach, Mountain.
	Sumach, Smooth.
	Sumach, Stag-horn.
	Walnut, black *(Juglans nigra)*.
	Weigela rosea.
	Willow, weeping *(Salix babylonica)*.
	Wistaria *(Wistaria consequana)*.
	Witch-hazel *(Hamamelis virginiana)*.
Citrus Canker *(Pseudomonas citri* Hasse*)*.	Citrus trees and plants, including the following:
	Bergamont *(Citrus bergamia)*. Includes various kinds of medicinal citrus
	Bigarade orange *(C. vulgaris)*. Includes the bittersweet, sour and others of this type.
	Citron *(C. Medica)*. Includes various varieties of citrons; also cedrat.
	Grapefruit, or Pomelo *(C. decumana)*.
	Hybrids. Includes the hybrids between various species of citrus—known under different names such as Morton, Rusk, Citrange, Pomerange, Tangelo, etc.
	Kumquat *(C. japonica)*. Includes the various kinds of kumquats.
	Lemon *(C. limonia)*. Includes various varieties of lemon, also rough lemon, everbearing lemon, ponderosa lemon.
	Lime *(C. limetta)*. Includes various varieties known as Key lime, Mexican lime, West Indian lime, etc.
	Mandarin Orange *(C. nobilis)*. This includes all varieties of "kid glove" oranges grown in Florida, such as Satsuma, Tangerine, King, Oneco, etc.

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Insect or Disease	Plants Likely to Become Infested or Infected
	Otaheite *(C. sinensis)*.
	Pomelo—See Grapefruit.
	Shaddock *(C. decumana)*.
	As separate from Pomelo. This includes several varieties.
	Sweet Orange *(C. aurantium)*.
	This includes all round oranges commonly grown for commercial purposes in Florida.
	Trifoliate Orange or "*Citrus trifoliata*" *(Poncirus trifoliata)*.
Cocoanut Bud-rot *(Bacillus coli* var.*)*.	Cocoanut.
Cotton Square-weevil *(Anthonomus vestitus* Boh.*)*.	Cotton.
Dictyospermum Scale *(Chrysomphalus dictyospermi* (Morg.*))*.	Arbor-vitae.
	Auracaria sp.
	Cape Jasmine.
	Citrus.
	Cycas.
	Erythrina indica.
	Ficus sp.
	Kentia belmoreana.
	Latania.
	Mango.
	Rose.
Gypsy Moth *(Porthetria dispar* Linn.*)*.	Alder, speckled *(Alnus incana)*.*
	Apple *(Pyrus malus)*.
	Ash, mountain *(Pyrus americana)*.
	Aspen, American *(Populus tremuloides)*.
	Aspen, large-toothed *(Populus grandidentata)*.
	Balm-of-Gilead *(Populus balsamifera)*.
	Beech, American *(Fagus grandifolia)*.
	Birch, gray *(Betula populifolia)*.
	Birch, paper *(Betula papyrifera)*.
	Birch, red *(Betula nigra)*.
	Box elder *(Acer negundo)*.
	Barberry, European *(Berberis vulgaris)*.
	Bayberry *(Myrica carolinensis)*.
	Birch, black *(Betula lenta)*.
	Birch, yellow *(Betula populifolia)*.
	Blueberry, low *(Vaccinium vacillans)*.
	Blueberry, tall *(Vaccinium corymbosum)*.
	Chestnut *(Castanea dentata)*.
	Cherry, sweet *(Prunus avium)*.
	Cherry, wild black *(Prunus serotina)*.
	Cherry, wild red *(Prunus virginiana)*.
	Chokeberry *(Aronia melanocarpa)*.
	Chokecherry *(Padus nana)*.
	Cottonwood *(Populus deltoides)*.
	Cranberry, American *(Oxyococcus macrocarpus)*.
	Elm, American *(Ulmus americana)*.

* List used through courtesy of the Federal Horticultural Board.

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Insect or Disease	Plants Likely to Become Infested or Infected
	Elm, European *(Ulmus campestris)*.
	Elm, slippery *(Ulmus fulva)*.
	Fern, sweet *(Comptonia peregrina)*.
	Gum, sweet, or red *(Liquidamber styraciflua)*.
	Gum, black *(Nyssa sylvatica)*.
	Gale, sweet *(Myrica gale)*.
	Hawthorn *(Crataegus* sp.*)*.
	Hazelnut *(Corylus americana)*.
	Hazelnut, Beaked *(Corylus rostrata)*.
	Hemlock *(Tsuga canadensis)*.
	Hickory, bitternut *(Hickoria cardiformis)*.
	Hickory, mockernut *(Hickoria alba)*.
	Hickory, pignut *(Hickoria glabra)*.
	Hickory, shagbark *(Hickoria ovata)*.
	Hornbeam, American *(Carpinus caroliniana)*.
	Hophornbeam *(Ostrya virginica)*.
	Larch, American *(Larix laricina)*.
	Larch, European *(Larix decidua)*.
	Linden, American *(Tilea americana)*.
	Linden, European *(Tilea* sp.*)*.
	Maple, Norway *(Acer plantanoides)*.
	Maple, red or swamp *(Acer rubrum)*.
	Maple, silver *(Acer saccharinum)*.
	Maple, sugar *(Acer saccharum)*.
	Oak, black *(Quercus velutina)*.
	Oak, rock chestnut *(Quercus primus)*.
	Oak, dwarf chestnut *(Quercus prinoides)*.
	Oak, burr *(Quercus macrocarpa)*.
	Oak, pin *(Quercus palustris)*.
	Oak, post *(Quercus stellata)*.
	Oak, red *(Quercus rubra)*.
	Oak, scarlet *(Quercus coccinea)*.
	Oak, bear *(Quercus ilicifolia)*.
	Oak, shingle *(Quercus imbricaria)*.
	Oak, swamp white *(Quercus bicolor)*.
	Oak, white *(Quercus alba)*.
	Poplar, Lombardy *(Populus nigra)*.
	Pine, pitch *(Pinus rigida)*.
	Pine, red *(Pinus resinosa)*.
	Pine, Scotch *(Pinus sylvestris)*.
	Pine, western white *(Pinus monticola)*.
	Pine, white *(Pinus strobus)*.
	Plum, beach *(Prunus maritima)*.
	Pear *(Pyrus communis)*.
	Poplar, silver *(Populus alba)*.
	Rose, pasture *(Rosa virginiana)*.
	Service-berry *(Amelanchier canadensis)*.
	Sumac, mountain *(Rhus copallina)*.
	Sumac, scarlet *(Rhus glabra)*.
	Sumac, staghorn *(Rhus hirta)*.
	Spruce, black *(Picea mariana)*.
	Spruce, Norway *(Picea abies)*.
	Spruce, red *(Picea rubens)*.
	Spruce, white *(Picea canadensis)*.

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Insect or Disease	Plants Likely to Become Infested or Infected
	Sassafras *(Sassafras sassafras).*
	Willow, white *(Salix alba).*
	Willow, glaucous *(Salix discolor).*
	Willow, sandbar *(Salix interior).*
	Witch-hazel *(Hamamelis virginiana).*
Mediterranean Fruit Fly *(Ceratitis capitata* Wied.*).*	Almond *(Amygdalus communis).**
	Amatungula *(Carissa bispinosa) (C. arduina).*
	Apple *(Malus sylvestris) (Pyrus malus).*
	Apricot *(Prunus armeniaca).*
	Avocado *(Persea americana) (P. gratissima).*
	Banana *(Musa sapientium).*
	Barbados gooseberry *(Pereskia aculeata).*
	Barbary Fig *(Opuntia vulgaris).*
	Bean *(Phaseolus vulgaris).*
	Belladonna *(Atropa belladonna).*
	Carica quercifolia.
	Carambola *(Averrhoa carambola).*
	Cayenne or Surinam cherry *(Eugenia uniflora) (E. michelii).*
	Cerbera thevetia (Thevetia neriifolia).
	Cherimoya *(Annona cherimola).*
	Chinese inkberry *(Cestrum* spp.*).*
	Chrysobalanus ellipticus.
	Citron *(Citrus medica).*
	Cocoa-plum *(Chrysobalanus icaco).*
	Coffee *(Coffea arabica).*
	Eggplant *(Solanum melongena).*
	Elengi tree *(Mimusops elengi).*
	Fig *(Ficus carica).*
	Granadilla *(Passiflora quadrangularis).*
	Grape *(Vitis vinifera).*
	Grapefruit *(Citrus grandis) (C. decumana).*
	Grumixiama or Brasilian cherry *(Eugenia dombeyi) (E. brasiliensis).*
	Guava *(Psidium guajava).*
	Japanese persimmon *(Diospyros kaki).*
	Jerusalem cherry *(Solanum capsicastrum).*
	Kafir-plum *(Harpephyllum caffrum).*
	Kei apple *(Dovyalis caffra) (Aberia caffra).*
	Kumquat *(Fortunella japonica)* *(Citrus japonica).*
	Lemon *(Citrus limonia)* *(C. medica* var. *limon).*
	Lime *(Citrus aurantifolia) (C. limetta).*
	Loquat *(Eriobotrya japonica).*
	Malay apple *(Caryophyllus malaccensis). (Eugenia malaccensis).*
	Mammee apple *(Mammea americana).*

* List used through courtesy of the Federal Horticultural Board.

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Insect or Disease	Plants Likely to Become Infested or Infected
	Mandarin orange *(Citrus nobilis deliciosa).*
	Mango *(Mangifera indica).*
	Medlar *(Mespilus germanica)* *(Pyrus germanica).*
	Natal plum *(Carissa grandiflora).*
	Noronhia emarginata.
	Orange jessamine *(Chalcas exotica) (Murraya exotica).*
	Papaya *(Carica papaya).*
	Passion flower *(Passiflora caerulea).*
	Peach *(Amygdalus persica)* *(Prunus persica).*
	Pineapple *(Ananas sativus).*
	Prickly pear *(Opuntia tuna).*
	Quince *(Cydonia oblonga).* *(Pyrus cydonia).*
	Red peppers *(Capsicum* spp.*)*
	Rose apples *(Caryophyllus jambos).* *(Eugenia jambos).*
	Round Kamani Mastwood *(Calophyllum inophyllum).*
	Sapodilla, Chicle *(Achras sapota).*
	Sour cherry *(Prunus cerasus).*
	Sour or Seville Orange *(Citrus aurantium).*
	Soursop *(Annona muricata).*
	Squash, pumpkin, gourd *(Cucurbita* spp.*)*
	Starapple *(Chrysophyllum cainito).*
	Strawberry guava *(Psidium cattleyanum).*
	Sweet orange *(Citrus sinensis).*
	Tomato *(Lycopersicon esculentum).*
	Winged kamani *(Terminalia catappa).*
Mexican Orange Maggot, or Morelos Fruit Worm *(Anastrepha (Trypeta) ludens* Loew.*).*	Guava *(Psidium guajava).**
	Mango *(Mangifera indica).*
	Orange *(Citrus sinensis* and *C. aurantium).*
	Peach *(Amygdalus persica).*
	Plum *(Prunus* spp.*).*
	Sapodilla *(Achras sapota).*
	Sweet lime *(C. limetta).*
Mango Seed Weevil *(Cryptorhynchus mangifera* Fab.*).*	Mango fruit and seed.
Pineapple Black Weevil *(Metamasius ritchiei* Marshall*).*	Pineapple.
Pink Bollworm *(Gelechia gossypiella* Saund.*).*	Cotton.
Spiny Citrus White-fly *(Aleurocanthus woglumi* Ashby*).*	Avocado.
	Capparis spp.
	Cestrum nocturnum.
	Citrus.
	Coffee.
	Guava.
	Lignum vitae.
	Mango.
	Salacea reticulata.

* List used through courtesy of the Federal Horticultural Board.

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Rule 1*. Inspectors employed by the Plant Board shall examine citrus plants and plant products in nurseries, orchards and other properties within the State of Florida, in order to determine whether these plants or plant products are infected with citrus canker, and shall report their findings to the Plant Board.

Rule 2*. The planting, transplanting or otherwise moving of any plants which are infected with citrus canker, or which, in the opinion of an inspector of the Plant Board, are likely to carry canker infections, is prohibited.

Rule 3†. All plants found to be infected with citrus canker shall be entirely destroyed by burning, and without being cut, or otherwise handled or moved. Further, the ground shall be thoroughly burned for a distance of three feet beyond the utmost spread of the branches of the infected plant; provided, however, that the Plant Pathologist, acting under the direction of the Plant Commissioner, may carry on such experiments with infected trees as the Plant Commissioner may deem advisable, as looking toward the control and cure of citrus canker. Said experiments shall be conducted under such conditions as will not endanger healthy trees by the spread of citrus canker.

Rule 4‡. The movement of all trees and plants commonly known as nursery stock, including budwood and scions, which do not have attached thereto a proper certificate tag, issued by the State Plant Board, and which have not been prepared for movement in accordance with the Rules and Regulations of the State Plant Board, in other respects, is hereby prohibited.

Rule 4A§. The following insect pests and diseases are hereby declared to be especially injurious and are declared to be insect pests and diseases which should be controlled and their dissemination prevented, within the intent and meaning of Section 12 of the Florida Plant Act of 1915:

Insect, Pest or Disease	Plants Likely to Become Infested or Infected
Anthracnose of Banana *(Gleosporium musarum)*.	Banana.
Argentine Ant *(Iridomyrmex humilis* Mayr*)*.	Fig, Orange.
Australian-pine-tree Borer *(Chrysobothris impressa* Fab.*)*	Australian pine *(Casuarina equisetifolia)*.
Bay-tree White-fly *(Paraleyrodes perseae* Quaintance*)*.	Avocado, Citrus, *Persea carolinensis*.
Blight *(Bacillus amylovorus)*.	Apple, Loquat, Pear.
Blue-green Citrus Beetles *(Pachnaeus opalus* Oliv., *P. distans* Horn, *P. litus* Germar, and *P. azurescens* Gyllenhal*)*.	Citrus.
Boll Weevil *(Anthonomus grandis* Boh.*)*.	Cotton.
Bundle Blight *(Pseudomonas vascularum)*.	Sugar cane.
California Red Scale *(Chrysomphalus aurantii (*Maskell*))*.	Citrus, Rose.
Camphor Thrips *(Cryptothrips floridensis* Watson*)*.	Camphor.

* Adopted May 4, 1915.
† Adopted May 4, 1915. Amended June 19, 1915.
‡ Adopted May 4, 1915. Amended Feb. 14, Mar. 13, and April 10, 1916.
§ Adopted April 10, 1916. Amended May 8, Aug. 14, and Oct. 13, 1916, and Jan. 8, Feb. 12, and Mar. 12, 1917.

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Insect, Pest or Disease	Plants Likely to Become Infested or Infected
Cane Leaf-hopper (*Perkinsiella saccharicida* Kirkaldy).	Sugar cane.
Cane Sharpshooter (*Delphax saccharivora* Westwood).	Sugar cane.
Chaff Scale (*Parlatoria pergandii* Comst.).	Citrus, Camellia, *Cocus plumosa.*
Chestnut Bark Disease (*Endothia parasitica*).	Chestnut.
Citricola Scale (*Coccus citricola* Campbell).	Citrus, Elm, Nightshade, Pomegranate, Walnut.
Citrus Mealy-bug (*Pseudococcus citri* (Risso)).	Begonia, *Bignonia* sp., Bottle Bush (*Callistemon lanceolatus*), *Bouvardia* sp., *Ceanothus integerrimus*, Citrus, Coleus, Coffee, Cotton, Croton, *Cyperus alternifolius*, English ivy, Ferns (*Filicales*), *Fuchsia*, Guadalupe Island Palm (*Erythea edulis*), *Habrothamnus*, *Ipomea*, *Learii*, Oleander, Peony, Poinsettia (*Euphorbia pulcherrimma*), Pineapple, Pumpkin, Purple Passion Flower (*Passiflora violacea*), *Solanum douglasii*, *Solanum jasminoides*, *Strelitzia gigantea*, *Strelitzia regina*, Tobacco, Variegated Wandering Jew.
Citrus Scab (*Cladosporium citri*).	Citrus.
Cloudy-winged White-fly (*Aleyrodes nubifera* Berger).	Citrus, Indian Laurel, *Ficus nitida.*
Cottony Cushion-scale (*Icerya purchasi* Maskell).	Acacias, Ambrosia, Apple, Apricot, Australian pine, Banyan, Careless weed, Castor Bean, *Chenopodium*, Citrus, Cocoanut palm, Coleus, Dwarf flowering almond, Fig, Goldenrod, Grape, Gumbo limbo, Locust, Magnolia, Mulberry, Myrtle, Nettle, Nightshade, Peach, Pecan, Pepper, Pine, Pomegranate, Potato, Purslane, Quince, Rosa de Montana, Rose-geranium, Roses, Royal Poinciana, Sapodilla, Sheperd's needle, Spanish Lime, Spanish Mulberry, Spearmint (*Melicocca bijuga*), Stone-crop (*Sidum* sp.), Sunflower, Sweet gum, Verbena, *Veronica*, Walnut, White Oak, Willow.
Crown Gall (*Pseudomonas tumefaciens*).	Apple, Grape, Oleander, Peach, Pear, Plum, Rose.
Cuban Laurel Thrips (*Gynaikothrips useli* Zimmerman).	Citrus, *Ficus nitida.*
Dieback of Pecan (*Botryospheaeria berengeriana*).	Pecan.
Florida Red Scale (*Chrysomphalus aonidum* Linn.).	*Aspidistra lurida*, *Auracaria bidwelli*, Australian oak (*Grevillea robusta*), Banana, *Begonia magnifica*, Camphor-tree, Cinnamon, Citrus, Cocoanut, Coffee, *Dictyospermum album*, Eucalyptus, *Ficus*

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Insect, Pest or Disease	Plants Likely to Become Infested or Infected
	elastica, Ficus nitida, Guava, *Ilex latifolia, Ilex lurida,* Japonica, Mammee apple *(Mammea Americana),* Mango, Oleander, Palms, *Pandanus, Rhododendron arboreum,* Rose.
Florida Wax-scale *(Ceroplastes floridensis* Comstock*).*	*Andromeda, Anona reticula, Anthurium,* Cinnamon, Citrus, *Euonymus japonicus,* Fig, Guava, *Ilex glabra,* Lignum-vitae, Mango, Myrtle, Oleander, Pomegranate, Quince, Red Bay, Tea.
Florida White-fly *(Aleyrodes floridensis* Quaintance*).*	Avocado, Guava.
Foot Rot *(Fusarium limonis).*	Citrus.
Gray Fungus Gummosis *(Botrytis vulgaris).*	Lemon.
Japanese Wax-scale *(Ceroplastes ceriferus* Anderson*).*	Camellia, Coffee, Gardenia, Hibiscus, Mango, *Myrica cerifera,* Mandarin, Orange, Persimmon, Tea.
Leaf Blotch *(Cercospora fusca).*	Pecan.
Little Peach.	Peach.
Long Scale *(Lepidosaphes gloverii* (Packard)*).*	Citrus, *Magnolia fuscata.*
Mango Scale *(Pulvinaria psidii* Maskell*).*	Citrus, Fig, Guava, Henna Bush, Loquat, Mango, Mastic, Omelet tree *(Blighia sapoda),* Sapodilla, Satinleaf, Star-apple, Wild Rubber.
Melanose *(Phomopsis citri).*	Citrus.
Nursery Blight *(Phyllosticta caryae).*	Pecan.
Oriental Peach Moth *(Laspeyresia molesta* Quaintance*).*	Cherry, Japanese flowering cherry, Peach, Plum.
Papaya Fruit Fly *(Toxotrypana curvicauda* Gerstaecker*).*	Papaya *(Carica papaya).*
Peach Rosette.	Peach.
Peach Yellows.	Peach.
Pear Thrips *(Euthrips pyri* Daniel*).*	Pear.
Pecan Budworm *(Proteopteryx deludana* Clemens*).*	Hickory, Pecan.
Pecan Case-bearer *(Acrobasis nebulella* Riley*).*	Hickory, Pecan, Walnut, Wild Crab *(Crataegus).*
Pecan Girdler *(Oncideres cingulata* Say*).*	Hickory, Pecan, Persimmon, Rose, Walnut.
Pecan Rosette.	Pecan.
Pecan Scab. *(Fusicladium effusum).*	Pecan.
Pecan-tree Borer *(Sesia scitula* Harris*).*	Chestnut, Dogwood, Hickory, Oak, Pecan.
Powdery Scab.	Irish Potato.
Purple Mite *(Tetranychus mytilaspidis* Riley*).*	Citrus.

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Insect, Pest or Disease	Plants Likely to Become Infested or Infected
Purple Scale *(Lepidosaphes beckii* (Newman)*).*	*Banksia integrifolia, Cercidiphyllum japonicum,* Citrus, Croton, *Eleagnus,* Fig, *Ilex cornuta,* Oak, Olive, *Pomaderris apetala, Taxus cuspidata.*
Putnam's Scale *(Aspidiotus ancylus* (Putnam)*).*	Apple, Ash, Beech, Bladdernut, Cherry, Currant, Hackberry, Linden, Maple, Oak, Osage orange, Peach, Pear, Pecan, Plum, Quince, Snowball, Willow.
Pyriform Scale *(Protopulvinaria pyriformis* Ckll.*).*	Avocado, Cape Jasmine, English ivy, Guava, *Rhyncospermum.*
Red-banded Thrips *(Heliothrips rubrocintus* Giard*).*	Avocado, Guava, Mango.
Red and Black Citrus Weevil *(Praepodes vittatus* Linn., var. *rubrovittatus* Jekel*).*	Citrus.
Root Knot *(Heterodera schachti* Schmidt**).*	*Aloysia citriodora,* Asparagus, Banana, Bean, Beet, Begonia, Cabbage, Cantaloupe, Careless weed, Carrot, Catalpa, Cauliflower, Celery, Chrysanthemum, *Cissus discolora,* Coleus, Cotton, Cowpeas (most), Cucumber, Cyclamen, Daisy, Eggplant, Fig, Geranium, Grapes (old world), Hibiscus, Honeysuckle, Irish potato, Ivy, Japanese persimmon, Kale, Lettuce, Mulberry, Mustard, Okra, Peach, Peanut, Peas, Pecan, Peony, Papaya, Pepper, Pineapple, Pokeweed, *Primula obconica,* Quince, Radish, Rape, Rose, Salvia, Soy bean, Squash, Sweet potato, Sugar cane, Tobacco, Tomato, Violet, Watermelon, Wistaria.
Rot of Citrus *(Diplodia natalensis).*	Citrus.
Rufous Scale, or West Indian Red Scale *(Selenaspidus (Aspidiotus) articulatus* (Morg)*).*	Avocado, Citrus, Coffee, *Cordyline terminalis,* Custard apple, *Dictyosperma album, Ficus, Gardenia,* Jasminum, Mahogony, Mignonette bush *(Lawsonia), Pandanus,* Rose, Star apple, Tamarind.
San Jose Scale *(Aspidiotus perniciosus* Comst.*).*	Acacia, *Actinidia,* Alder, Almond, American linden, Apple, Apricot, Ash, Black walnut, Carolina poplar, *Catalpa speciosa,* Cedar, Chestnut, *Citrus trifoliata,* Cotoneaster, Crab-apple, Crataegus, Currant, Cut-leaved birch, Dogwood, Elm, English walnut, English willow, *Eucalyptus corynocalyx,* Euonymus, European linden, Golden-leaved poplar, Golden willow, Gooseberry, Hawthorn, Huckleberry, Japan plum, Japanese quince, Japan walnut, Juneberry, Laurel, Laurel-leaved willow, Lemon, Lime, Lombardy poplar, *Lonicera xylosteum,*

* "*Heterodera radicola* (Müller) Atkinson."

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Insect, Pest or Disease	Plants Likely to Become Infested or Infected
	Maple, Milkweed, Orange, Osage orange, *Prunus Avium*, Peach, Pear, Pecan, Persimmon, Poplar, *Prunus domestica*, Plum, *Prunus pissardi*, *Prunus maritima*, *Ptelea trifoliata*, Quince, Raspberry, Rose, Snowball, Spiraea, Spruce, Strawberry, Sumac, *Symphoricarpus racemosus*, Weeping Willow.
Scab (*Actinomyces chromogenus*).	Irish potato.
Scaly Bark (*Cladosporium herbarum*, var. *citricolum*).	Citrus.
Sericeous Palm Weevil (*Metamasius sericeus Ol.*).	Cocoanut palm, Royal palm, Sugar cane.
Six-spotted Mite (*Tetranychus sexmaculatus* Riley).	Citrus.
Snow Scale (*Chionaspis citri* Comst.).	Citrus, *Euonymus latifolius*, *Osmanthus*.
Soft Brown Scale (*Coccus hesperidum* Linn.).	*Abutilon*, *Morus nigra*, Box, Camellia, Cinnamon, Citrus, *Clematis flammula*, *Convolvulus tricolor*, *Cycas revoluta*, Holly, Ivy, Jasmine, Laurel, Mimosa, Myrtle, Oleander, Phlox.
Stem-end Rot (*Phomopsis citri*).	Citrus.
Striped Citrus Weevil (*Diaprepes abbreviatus* Linn, var. *spengleri* Linn.).	Citrus.
Sugar-cane Borers (*Diatraea saccharalis crambidoides* Fab. and *D. zeacolella* Dyar).	Corn (maize), Johnson grass, Sorghum, Sugar cane.
Sugar-cane Mealy-bug (*Pseudococcus calceolariae* Maskell).	Johnson grass, Sugar cane.
Sweet Potato Root-weevil (*Cylas formicarius* Oliv.).	Sweet potato, Morning glory.
Walnut Scale (*Aspidiotus juglans-regiae* Comst.).	Apple, Apricot, Cherry, Japan plum, Locust, Maple, Peach, Pear, Pecan, Walnut.
White Peach Scale (*Aulacaspis pentagona* (Targ.)).	Acanthus, Apricot, *Argyriea speciosa*, *Bryophyllum calycinum*, *Callicarpa lanata*, *Calotropis procera*, Cape gooseberry, Capsicum, *Carica papaya*, Cherry, China-Berry, *Cydus media*, Dwarf Cherry, Dwarf flowering almond, Dwarf peach, Fuchsia, Geranium, *Gossypium barbadense*, Granadilla, Grape, Hibiscus, *Hibiscus (Abelmoschus) esculentus*, Japanese varnish tree, Japan flowering cherry, Jassium, Locust, Morning glory, Mulberry, *Myoporum insulare*, Oleander, *Passiflora*

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Insect, Pest or Disease	Plants Likely to Become Infested or Infected
	edulis, Peach, Pear, Pecan, Pelargonium, Persimmon, Plum, *Polygala myrtifolia*, Privet, Prune, *Prunus pandula*, *Prunus pseudo-ceraceus*, *Tylophora asthmatica*, Walnut, Yellow Jasmine.
White-winged White-fly (*Aleyrodes citri* Riley & Howard).	Blackberry, Boston ivy, Button bush (*Cephalanthus occidentalis*), Cape jessamine (*Gardenia*), Cherry laurel, Chinaberry, Citrus, Coffee, English Ivy, *Ficus* sp., Green ash, Honeysuckle, Japonica (*Camellia japonica*), Jessamine (*Jasminum* sp.), Mexican orange (*Choisya ternata*), Oleander, Osage orange (*Maclura aurantiaca*), Persimmon (Japanese and native), Pomegranate, Portugal cherry, Prickly ash, Smilax, Scrub palmetto, Tree-of-Heaven, Trumpet flower (*Tecoma radicans*), *Viburnum nudum*, Water oak, Wild olive.
Withertip (*Colletotrichum gloesporioides*).	Avocado, Citrus, Mango.
Woolly White-fly (*Aleyrodes howardii* Quaintance).	Citrus.
Zizyphus Scale (*Parlatoria zizyphus* Lucas).	Citrus, Date-palm, *Zizyphus pinna-christi*.

Rule 4B.* No certificate shall be issued for the movement of any nursery stock until such stock shall have been inspected by an agent of the State Plant Board, and found to be apparently free from especially injurious insect pests or diseases. Should any especially injurious insect pest or disease be found, either on the nursery stock or on the premises, no certificate shall be issued until such insect pest or disease has been suppressed to the satisfaction of the Nursery Inspector. No certificate shall be issued when the nursery stock is exposed to infestation or infection from any especially injurious insect pest or disease that occurs within one-fourth mile from where any part of said nursery stock is located; provided, however, that the nurseryman may remove such stock under the direction of the Nursery Inspector, and under such precautions as he may specify, and provided, further, that nothing in this rule shall be construed as preventing the enforcement of quarantines to a greater distance than one-fourth mile in the case of properties declared by the Board to be infested or infected with any insect pest or disease declared to be a public nuisance.

Rule 4C.* All shipments of nursery stock, and every package thereof, transported within, into, or out of the State of Florida, shall be completely and securely boxed or covered to prevent infestation or infection by injurious insect pests or diseases. Carload shipments in bulk shall be in cars with openings effectually screened or closed.

Rule 4D.* All nursery stock, except those plants that will not stand defoliation, shall be completely defoliated, including leaf-stalks. Citrus must always be defoliated. All nursery stock shall be handled in such a manner that none of the leaves or clippings shall become mixed with any packing material.

Rule 4E.* All apple, pear, plum, and peach stock and all other host plants of San Jose scale which will stand fumigation, shall be fumigated

* Adopted April 10, 1916.

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with hydrocyanic-acid gas immediately before being delivered for transportation. Every nurseryman shall have his fumigation box or house completed and in order, with necessary chemicals at hand, ready to demonstrate his ability to fumigate nursery stock, at the time of inspection. No certificate shall be issued until the fumigating facilities have been approved by the Nursery Inspector.

Rule 4F.* Any certificate may be revoked and all certificate tags recalled, at any time, for any violation of the provisions of the Florida Plant Act of 1915, of the Rules and Regulations of the State Plant Board, or of the requirements of the Nursery Inspection Department.

Rule 4G.* Until further notice is given, or at the discretion of the Nursery Inspector, the plants and parts thereof listed herewith, when apparently free from injurious insect pests and diseases, need not be inspected, but may be sold, exchanged or transported without a certificate tag attached. These exceptions do not apply to any plants or parts thereof imported from foreign countries, nor from the possessions of the United States not on the mainland of North America:

> Florida-grown forest trees and forest shrubs when not grown in a nursery; seed (except mango and avocado seed, and cotton seed in localities infested with the Cotton Boll Weevil); vegetable plants and other herbaceous plants; the roots, bulbs and tubers of vegetables and other herbaceous plants; cut flowers and pineapple plants.

Rule 5†. Every grove, nursery or separate plant situated in the State of Florida which has been found to be infected with citrus canker is hereby declared to be the center of an infected and dangerous zone, which zone shall extend for a mile in every direction from said center, and within which center and zone all citrus trees or citrus nursery stock are declared to be plants likely to carry and disseminate citrus canker. The planting or movement of citrus plants within such zone is hereby prohibited, and the movement of non-citrus plants from within such infected grove or nursery is likewise prohibited until such time as in the judgment of the Board such dangerous conditions may have ceased to exist; provided, that citrus trees or plants in such zone may be moved within a property located more than one-quarter of a mile from the center of such zone when moved under the supervision of an agent of the Plant Board, and provided, further, that citrus trees or plants from properly certified nurseries may be planted within such zone at distances exceeding one-half mile from the center thereof, and provided, further, that citrus trees or plants located within such zone may be budded by and with the consent and approval of the Plant Commissioner under such precautions and conditions as he may specify.

No certificate shall be issued for the movement of nursery stock from a nursery in which vehicles, teams, laborers or other persons, nursery implements or other things enter, that likewise enter or are used in any nursery or grove infected with citrus canker.

Rule 6‡. The Nursery Inspector shall be required to have prepared and shall arrange that any person entitled thereto may secure, under such conditions as the Nursery Inspector may name, certificates in proper form and serially numbered, to be affixed to any nursery stock the movement of which is permissible under the provisions of the Florida Plant Act of 1915.

The Nursery Inspector shall be further required to keep in his office exact records covering the issuance of all such certificates and the movement of nursery stock for which such certificates have been used, and the persons by whom such certificates have been secured shall be required to provide the Nursery Inspector, at any time and in such manner as he may designate, with the information necessary for the keeping of such records.

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* Adopted April 10, 1916.

† Adopted June 18, 1915. Amended Jan. 10, 1916, May 8, 1916, Aug. 14, 1916, and Oct. 13, 1916.

‡ Adopted June 19, 1915. Amended Nov. 8, 1915, Feb. 14, 1916, and April 10, 1916.

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The Nursery Inspector shall have authority to call for the return of any unused certificates at his discretion.

The cost of printing such certificates shall be paid by the nurseryman to whom furnished and in case any certificates are recalled before used the cost thereof shall be refunded to the nurseryman.

The forms of certificates to be issued to cover the movement of nursery stock shall be as follows:

FORM NO. 1 (Serial Number)

Issued....., 191.....

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

NURSERY CERTIFICATE

The undersigned hereby certifies that the.....
nursery stock, in the nurseries of.....
located at....., Florida, has been thoroughly inspected. The stock, premises and adjacent properties have been found to be apparently free from especially injurious insect pests and diseases. The owner has agreed to completely defoliate (when possible) and to fumigate properly with hydrocyanic-acid gas, or to otherwise treat as directed, all stock sold or moved under this certificate, as provided in the Rules and Regulations.

A complete list of plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

The use of this certificate tag upon nursery stock which has not been inspected by a duly appointed nursery inspector of the Plant Board is a violation of the law and will be prosecuted.

Approved:

....
Plant Commissioner. Nursery Inspector.

FORM NO. 2 (Serial Number)

Issued....., 191.....

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

NURSERY DEALER'S CERTIFICATE

The undersigned hereby certifies that the nursery stock sold by .....of....., Florida is apparently free from injurious insect pests and diseases, and that the same may be transported under the provisions of the Florida Plant Act of 1915.

The undersigned further declares that.....
has furnished him with names and addresses of the persons from whom and the localities where he purchased or obtained the nursery stock sold under this certificate.

A complete list of the plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

Approved:

....
Plant Commissioner. Nursery Inspector.

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FORM NO. 3 (Serial Number)

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

PACKAGE CERTIFICATE

....., Fla., ..., 19.....

This is to certify that the contents of this package from..... of....., Florida, addressed to..... of....., State of....., have been carefully inspected and found to be apparently free from especially injurious insect pests and diseases and may be sold and transported under the provisions of the Florida Plant Act of 1915.

The owner has agreed to defoliate (when possible), and to properly disinfect as directed by the Inspector, the contents of this package.

A complete list of the plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

The use of this certificate tag upon nursery stock which has not been inspected by a duly appointed nursery inspector of the Plant Board is a violation of the law and will be prosecuted.

.....
Nursery Inspector.

.....
Inspector.

FORM NO. 4 (Serial Number)

Issued....., 191.....

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

NURSERY CERTIFICATE

The undersigned hereby certifies that the..... nursery stock in the nurseries of.....located at....., Florida, has been thoroughly inspected.

The stock, premises and adjacent properties have been found to be apparently free from especially injurious insect pests and diseases, but are located in scaly-bark territory. The owner has agreed to completely defoliate (when possible) and to fumigate with hydrocyanic-acid gas, or to otherwise treat as directed, all stock sold or moved under this certificate, as provided in the Rules and Regulations.

A complete list of all plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

The use of this certificate tag upon nursery stock which has not been inspected by a duly appointed nursery inspector of the Plant Board is a violation of the law and will be prosecuted.

Approved:

....
Plant Commissioner. Nursery Inspector.

The reverse side of the above tag to read as follows:

"Important. Read Carefully.

"This shipment is from a nursery located in Scaly Bark territory. It may be moved to any point in the following defined areas*: Pinellas County; the area bounded on the east by the Indian River, on the west by the St. Johns River, on the north by the northern boundary of the town of Cocoa and on the south by the southern boundary of the town of Bonaventure; the area bounded on the east by the Banana River, on the west by the In-

* For description of Scaly Bark areas as at present defined, see amended Public Notice on page 148.

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dian River, on the north by Banana Creek, and on the south by the southern boundary of the town of Georgiana (meaning Fairyland Grove); the area extending three miles in all directions from the Station of Knights in Hillsboro County, and the property of the Allapatahatchee Fruit and Vegetable Co., occupying the E½ of the NE¼, the SW¼ of the NE¼, the S½ of the NW¼ of the NE¼, and the N½ of the SE¼ of Sec. 27, Township 35 South, Range 39 East. It will be a violation of the law to plant these trees in any other section of the State. *Railroad and express agents* shall not accept shipments bearing this tag for points not located in the above-named areas."

The words "SCALY BARK" shall be printed in red letters directly over the wording on both sides of this tag.

FORM NO. 5 (Serial Number)

FLORIDA STATE PLANT BOARD
Office of Plant Commissioner,
Gainesville, Fla.

PORT AND RAILWAY INSPECTION CERTIFICATE

....., Fla., ..., 19.....

This is to certify that the undersigned has this day inspected the contents of this package from....., ... consigned to....., State of....., and has found them apparently free from especially injurious insects, pests and diseases. No plants or plant products were found therein, the importation of which is prohibited by the Rules of the State Plant Board of Florida under the Florida Plant Act of 1915.

All persons are warned, under penalty of the law, not to use this certificate tag upon any shipment, or upon any plants or plant products, other than those described and inspected as above.

Authorized:

....
Plant Commissioner. Deputy Port and Railway Inspector.

Rule 7.* Any person affected by any rule or regulation made or notice given pursuant to the Florida Plant Act of 1915, may have a review thereof, for the purpose of having such rule, regulation or notice modified, suspended or withdrawn, by filing a written request with the Chairman of the State Plant Board, stating the particular rule, regulation or notice regarding which action is desired and setting forth the objections to the enforcement of said rule, regulation or notice.

At the time of filing said written request the person asking for such review shall deposit a certified check for one hundred and fifty dollars ($150) with the Chairman of the Board or, in case the destruction of property is involved, with the agent of the Board responsible for the carrying out of the provisions of the Florida Plant Act of 1915 in the locality in which the property affected is located. Said sum of $150 is to be applied towards defraying the expenses of a special meeting of the Board, providing the Chairman considers the exigencies of the case require action before the next regular meeting.

In case such special meeting is called the Secretary of the Board shall present an account of the expenses incurred for holding said meeting and if these expenses are less than $150 the balance shall be returned to the person requesting the review.

On such review all facts and representations offered on behalf of the applicant or on behalf of the Board may be presented to the Board in the form of affidavits.

The operation or enforcement of any rule or regulation made or notice given by the Board is not to be held in abeyance pending a review thereof

* Adopted June 19,1915.

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but is to remain in full force and effect until modified, suspended or withdrawn by action of the Board. Providing that where the enforcement of a rule requires the destruction of the property of the party making the appeal to the Board in the manner aforesaid and the said sum of $150 to cover costs having been deposited with an agent of the Board, such destruction shall be suspended until the party shall have had the opportunity of being heard on his appeal; provided that the party thus appealing complies with the instructions of the agent of the Board to the end that no especially injurious insect pest or disease shall be disseminated.

Rule 8.† The planting, cultivating or harvesting of any truck or field crop in a grove or nursery which is, has been, or shall become infected with citrus canker, is hereby prohibited until such time as the Plant Commissioner may deem such procedure unlikely to spread citrus canker.

Rule 9.* Hereafter, work in properties infected with citrus canker shall be carried on by the owner or his employees, under the general supervision of agents of the Plant Board, appointed especially for this purpose. Said agents shall have authority such that in case the work in infected properties is being carried on in such manner as to make likely the spread or dissemination of citrus canker, whether within the affected property or other properties, they may so restrict the manner of carrying on such work as to prevent as far as possible the spread of the disease.

Rule 10‡. The harvesting of citrus fruits from any grove which is, has been or shall become infected with citrus canker is hereby prohibited except when such harvesting shall be carried on under the immediate supervision of an agent of the Plant Board whose wages shall be paid by the owner of the fruit, at the time it is picked. Said agent of the Board shall be authorized to prescribe such precautions in connection with the harvesting of such fruit and the hauling or otherwise moving thereof as shall, as far as possible, render unlikely the fruther dissemination of citrus canker.

The packing of citrus fruit from such an infected property shall be carried on only under the immediate supervision of an agent of the Board whose wages shall be paid by the person operating the packing house at which the fruit is prepared for shipment, or in case such fruit is not prepared for shipment in a packing house, by the person owning the fruit at the time it is packed. Said agent shall be authorized to prescribe such precautions in connection with the packing and otherwise handling of such fruit for shipment as shall, as far as possible, render unlikely the further dissemination of citrus canker.

The shipment of citrus fruit consigned to any point in the State of Florida from such an infected grove or from any packing house in which the fruit from such an infected grove has been prepared for shipment, is hereby prohibited.

The shipment of citrus fruit in bulk or otherwise than wrapped and packed in standard crates from such infected property or from any packing house in which fruit from an infected property is prepared for shipment is hereby prohibited, and the acceptance thereof for transportation by a common carrier is likewise prohibited.

Provided that this rule shall not apply to such properties as have been declared by the Board as no longer infected with citrus canker.

Rule 11A§. The shipment, transportation or carrying of any and all citrus fruits, either by common carriers, dining or buffet cars, railway news companies or individuals, into the State of Florida from the States of Georgia, Alabama, Mississippi, Louisiana or Texas, which states have considerable areas infected with citrus canker, is hereby prohibited.

Rule 11B§. The shipment, transportation or carrying of any and all

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* Adopted July 12, 1915.
† Adopted July 12, 1915.
‡ Adopted August 9, 1915.
§ Adopted Aug. 9, 1915. Amended Dec. 13, 1915, Apr. 10, 1916, May 8, 1916, and Oct. 13, 1916.

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citrus fruits, either by common carriers, dining or buffet cars, railway news companies, or individuals into the State of Florida from the State of California, is hereby prohibited on account of the prevalence in that state of the disease known as the Brown Rot of lemons and oranges *(Pythiacystis citrophthora)*.

Rule 11C.* The importation of citrus fruits, sapodillas *(Achras sapotes)*, guavas, mangoes, peaches and plums into the State of Florida from Mexico, in which country the Morelos fruit worm or orange maggot *(Anastrepha (Trypeta) ludens)*, is known to occur, is hereby prohibited and such importations arriving at any port, railway station or other place in the State of Florida, or found in the waters adjacent thereto, shall be subject to immediate confiscation by agents of the Plant Board.

Rule 11D.* The importation into the State of Florida of any and all fruits, vegetables, plants or parts of plants listed by the Plant Board as hosts of the Mediterranean fruit fly *(Ceratitis capitata)* from Africa (Cape Colony, Congo, Delagoa, Dahomey, Nigeria, Transvaal and Uganda), Argentine Republic, Australia, Azores, Bermuda, Brazil, Cape Verde Islands, Europe (Italy, France, Malta, Spain and Sicily), Hawaiian Islands, Madeira and New Zealand, wherein the Mediterranean fruit fly is known to exist, is hereby prohibited and such importations arriving at any station, port or other place within the State of Florida, or found in the waters adjacent thereto, shall be subject to immediate confiscation by agents of the Plant Board, excepting that the following plant products may be admitted in the form herewith specified from the countries above-listed as being those in which the Mediterranean fruit fly is known to exist:

Coffee bean,
Figs (dried),
Grapes,
Lemons.

Rule 12†. On account of the danger of further spreading citrus canker the practice of using the leaves, twigs or branches of citrus trees and the products obtained therefrom for the purpose of disseminating the fungi used for the control of the white fly and citrus scale insects is hereby restricted to the use of such material as may be obtained from trees located outside the limits of any area declared by the Board to be dangerous on account of the prevalence of citrus canker therein and the picking, shipping or using of leaves, twigs or branches taken from trees located within such dangerous area is hereby prohibited.

Rule 13†. The owners, officers and employees of any nursery which may be found at any time to be infested or infected with any especially injurious insect pest or disease, or which has heretofore been so infested or infected, shall, on demand of the Plant Commissioner, furnish a list of all shipments and sales of nursery stock from said nursery from any date set by the Plant Commissioner up to and including the date of such demand. Said list shall show the names and addresses of all purchasers, the names and addresses of all consignees and a complete description of the stock included in each and every shipment.

Rule 14†. The importation into the State of Florida of banana plants or bulbs and the importation of cocoanut trees, plants or nuts is hereby prohibited. Providing that this rule does not apply to the importation of cocoanuts with the husks removed and not to be used for planting.

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* Adopted Aug. 9, 1915. Amended Dec. 13, 1915, Apr. 10, 1916, May 8, 1916, and Oct. 13, 1916.
† Adopted Sept. 13, 1915.

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PUBLIC NOTICE

Declaring Certain Areas Infected With the Disease Known as Scaly Bark

The following Public Notice regarding the existence of Scaly Bark in certain areas, adopted by the State Plant Board at its meeting held in Gainesville, Fla., March 12, 1917, supersedes the public notices on the same subject which were published on pages 24 and 25 of Circular No. 10, page 9 of Circular No. 11, page 1 of Circular No. 14 and page 5 of Circular 16 and embraces certain additional territory:

" Under the provisions of the Florida Plant Act of 1915, Chapter 6885 of the Laws of Florida, the State Plant Board in session at Gainesville, Florida, this 12th day of March, 1917, and in accordance with Section 12 of said Act, does declare the disease known as Scaly Bark *(Cladosporium herbarum* var. *citricolum)* to be a disease, the dissemination of which should be controlled, and hereby declares and gives public notice that the following areas are areas in which citrus trees are likely to be infected with said disease:

" Pinellas County; Merritts Island and a belt of land two miles wide in Brevard County bounded on the south by the southern boundary of Township 26 South, on the east by the Indian River and on the north by the County line, and Sections 2, 3, 4, 13, 14 and 24 in Township 20 South, Range 35 East and Section 19 in Township 20 South, Range 36 East; Townships 14 and 15 South in Range 32 East, Townships 15, 16 and 17 South in Range 33 East, Townships 17 and 19 South in Range 34 East; Township 19 South in Range 35 East and the N½ of Township 18 South in Range 34 East in Volusia County; Townships 28 and 29 South in Range 20 East, Townships 28 and 29 South in Range 21 East, Township 28 South in Range 22 East and Township 29 South in Range 19 East in Hillsboro County; Sections 21 and 22, Township 24 South, Range 16 East, near Hudson, Pasco County; Sections 16 and 17, Township 34 South, Range 25 East, near Wauchula, and Sections 17, 18, 19 and 20 in Township 33 South, Range 24 East, near Fort Green Springs, and Sections 8 and 17 in Township 36 South, Range 33 East, and Sections 1, 2 and 3 in Township 36 South, Range 32 East, and Sections 34, 35 and 36 in Township 35 South, Range 32 East, near Fort Bassenger, and Sections 28, 32 and 33 in Township 38 South, Range 24 East, near Nocatee, DeSoto County; that portion of Lake County bounded on the north by Dead River and Lake Harris, on the west and south by Lake Harris and on the east by the eastern boundary line of Range 25 East, and Sections 7, 8, 17, 18, 19 and 20 in Township 19 South, Range 27 East and Sections 13, 23 and 24 in Township 19 South, Range 26 East, near Eustis, Lake County; Township 21 South, Range 31 East, and that portion of Township 20 South, Range 31 East which is south and east of Lake Jessup, Seminole County; Sections 1 and 2, Township 22 South, Range 30 East, near Golden Rod, Orange County; Section 23, Township 25 South, Range 29 East, Section 4, Township 26 South, Range 30 East and Oliver's Island in Lake Tohopekaliga, and Sections 30 and 31 in Township 35 South, Range 33 East, near Bassenger, Osceola County; Sections 8, 9, 23, 24, 25 and 26 in Township 23 South, Range 19 East, and Sections 15, 16, 21, 22, 32 and 33 in Township 23 South, Range 20 East, near Brooksville, Hernando County; and the property of the Allapatahatchee Fruit and Vegetable Company, occupying the E½ of the NE¼, the SW¼ of the NE¼, the S½ of the NW¼ of the NE¼, and the N½ of the SE¼ of Section 27, Township 35 South, Range 39 East in St. Lucie County, State of Florida."

The following shipping points are located within the Scaly Bark territory defined above:

Allendale §	Bassenger ‡‡	Brantley *
Allenhurst *	Bayview ‡	Briggsville §
Anclote ‡	Belleair ‡	Canaveral *
Anona ‡	Belleview Hotel ‡	City Point *
Antioch †	Boca Ceiga ‡	Clearwater ‡
Artesia *	Bonaventure *	Clifton *
Aurantia *	Bowles §	Clifton §§
Banyan *	Brandon †	Cocoa *

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Coronado §
Courtenay *
Cross Bayou ‡
Daytona §
Daytona Beach §
Delespine *
Dover †
Dunedin ‡
Durant †
East Cove †
Footman *
Frontenac *
Fulton's Spur †
Ft. Bassenger ††
Ft. Green Springs ††
Ft. Green ††
Gabriella ||
Garret †
Gary †
Georgiana *
Glencoe §
Glenoak ‡
Golden Rod ||
Green Springs ‡
Gulfport ‡
Hardee †
Hawks Park §
Hillsboro †
Holly Hill §
Hucomer §
Idlewild Park †
Indianola *
Indian River City *
Indian Rock ‡
Johns Pass ‡
Keystone Colony ‡
Kimbrough ‡
Kingston §
Knights †
LaGrange *
Lake Charm §§
Lake Villa Junction ‡
Lane Park **
Largo ‡
Lellman ‡
Limona †
Lotus *
Lyrata *
Mango †
Maytown §
Merritt *
Mims *
Mortonhurst *
New Smyrna §
Nocatee ††
Oak Hill §
Oak Hurst ‡
Oceanus *
Orient †
Ormond §
Ormond Beach §
Oviedo §§
Ozona ‡
Pineda *
Pinellas ‡
Pinellas Park ‡
Plant City †
Ponce Park §
Port Orange §
Rockledge *
Safety Harbor ‡
Saint Petersburg ‡
Seabreeze §
Seaside ‡
Seffner †
Seminole Beach ‡
Seminole ‡
Sharpes *
Shiloh *
Sidney †
Sutherland ‡
Taconey ‡
Tampa †
Tarpon Springs ‡
Thonotosassa †
Thonotosassa Junction †
Titusville *
Tropic *
Turkey Creek †
Turnbull *
Valrico †
Veteran ‡
Wall Springs ‡
Wiley Ave. *
Wilson *
Ybor City †
Youmans †

* In Brevard County
† In Hillsboro County
** In Lake County
‡ In Pinellas County
§ In Volusia County
§§ In Seminole County
†† In DeSoto County
|| In Orange County
‡‡ In Osceola County

Rule 15.* The movement of citrus trees, or parts thereof, from the areas designated in the Public Notices by the State Plant Board as areas in which citrus trees are likely to be infected with Scaly Bark, into all parts of the State of Florida other than those specified as infected areas, is hereby prohibited.

This rule shall not apply to the movement of citrus fruits that are intended as food products.

Rule 16.† Every grove, field, nursery or other property in which has been found any disease or insect pest which has been declared a public nuisance by the State Plant Board under the provisions of the Plant Act of 1915, shall be conspicuously posted with signs warning all parties against trespassing, said signs to read as follows: "No Trespassing. By Order of The State Plant Board." The words "NO TRESPASSING" to be in letters no less than four inches in height and the words "State Plant Board" to be in letters not less than two and one-half inches in height, such letters to be

* Adopted Oct. 11, 1915.
† Adopted Nov. 8, 1915. Amended Feb. 14, 1916.

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of prominent bold-faced type, easily read. The mutilation, defacing, removing or destroying of such signs by any parties whomsoever is hereby prohibited. Provided that the posting of such notices shall not be required in the case of any property which has been declared by the State Plant Board to be no longer a danger center.

Rule 17*. The introduction into the State of Florida through the ports thereof of plants, fruits, vegetables or other material that is likely to introduce insect pests or diseases especially injurious to the agricultural and horticultural interests of the State is hereby prohibited; provided, however, that plants, parts of plants, fruits or vegetables, the importation of which into the State has not been specifically prohibited, and which shall be found upon inspection by a properly appointed agent of the Plant Board to be apparently free from such especially injurious insect pests and diseases shall be permitted to enter the State and be transported, sold, or exchanged within the State.

Rule 18†. To prevent the introduction of the cotton boll weevil into the non-infested territory in the State of Florida, from any region in Florida or from other states or territories in which the boll weevil is known to exist, the shipment or transportation of the following articles from boll weevil infested territory, into non-infested territory in the State of Florida, is hereby prohibited: Seed cotton, cotton, cotton seed, cotton seed hulls, seed cotton sacks (used), cotton picker's sacks (used), Spanish moss, corn in shuck, living boll weevils in any stage, cotton plants or parts of cotton plants (baled cotton, cotton seed meal, cotton seed cake and cotton seed oil excepted) and shipments of household goods or other commodities containing any of the foregoing; provided, that this restriction shall not apply to shipments of cotton seed hulls between January 1st and August 1st of each year, or to corn in shuck between July 1st and September 30th of each year; and provided, further, that shipments of cotton seed for planting purposes may be made when such shipments are accompanied by the certificate of a State or Government entomologist stating that such seed has been fumigated in a manner to kill any boll weevils that may be contained therein; and provided, further, that permits may be issued by the Plant Commissioner for shipment of cotton seed hulls into the non-infested section of Florida, from cotton oil mills located in the boll weevil infested territory under such precautions and safeguards as to milling, packing, handling and shipping as he may specify.

Shipments of household goods originating in any boll weevil infested territory of the State of Florida, or in any other state or territory, when shipped into the non-infested portion of Florida, shall be accompanied by an affidavit showing that said shipments do not contain any of the articles above listed and the shipment of which into the non-infested portion of Florida is prohibited.

The keeping or having in possession of any living boll weevils, or any eggs, living larvae, or living pupae of said insect, in the non-infested portion of the State of Florida, is hereby prohibited.

The Plant Commissioner shall, from time to time, publish and define the territory in the State of Florida which is considered to be boll weevil infested territory and which is defined as such within the meaning of this regulation.

All rules and regulations of the Plant Board in conflict with this rule are hereby rescinded.

BOLL WEEVIL INFESTED TERRITORY IN FLORIDA—DEFINED.

In accordance with Rule No. 18, adopted by the State Plant Board of Florida December 13, 1915, and amended November 13, 1916, the Plant Commissioner has defined, and does hereby define, as a result of actual inspections made by agents of the State Plant Board, the Counties of Nassau, Duval, Clay, Bradford, Alachua and Levy and all counties west and north

* Adopted Nov. 8, 1915. Amended Dec. 13, 1915.
† Adopted Dec. 13, 1915. Amended Nov. 13, 1916.

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thereof, in the State of Florida, as being boll weevil infested territory within the meaning of said Rule.

PUBLIC NOTICE *

Declaring Certain Areas to Be Infected With Withertip

Under the provisions of the Florida Plant Act of 1915, Chapter 6885 of the Laws of Florida, the State Plant Board, in session at Jacksonville, Florida, this 14th day of February, 1916, and in accordance with Section 12 of said Act, does declare the disease known as Withertip *(Colletotrichum gloesporiodes)* to be a disease, the dissemination of which should be controlled, and hereby declares, that while this disease is generally distributed throughout the State, the following areas are areas in which this disease is not known to exist; the area bounded on the south by the waters of the Bay of Florida, on the west by the Gulf of Mexico, on the north by White Water Bay and its tributaries, and on the east by the eastern boundary-line of Monroe County.

Rule 19*. The movement of citrus trees, or parts thereof, into the areas designated in the public notices by the State Plant Board, as areas in which withertip is not known to exist, is hereby prohibited.

This rule shall not apply to the movement of citrus seed under package certificate issued by a duly appointed inspector of the Plant Board.

Rule 20*. Any and all plants or plant products subject to the provisions of the Florida Plant Act of 1915, whether in transit or in the hands of possessor, may be held for inspection regardless of whether they are certified or not, and if such plants or plant products are found to have been moved or transported in violation of the rules or regulations of the Plant Board, or if found infested or infected with any injurious insect pest or disease, such plants or plant products must be deported, sprayed or otherwise treated upon the order of the Plant Commissioner, if in his opinion this is necessary for the protection of the agricultural or horticultural interests of the State.

Rule 21†. The sale, gift, exchange, shipment or movement of trees, plants or plant products infested or infected with any of the insects or diseases listed by the Board in accordance with Section 12 of the Florida Plant Act of 1915, is hereby prohibited, except when specifically authorized by the Plant Commissioner or his duly authorized representative. This rule shall not apply to the movement of plant products that are intended as food products unless in the opinion of the Plant Commissioner such shipment will be dangerous to the agricultural and horticultural interests of the State.

Rule 22*. The movement of nursery stock from a nursery in which Cottony Cushion Scale is known to have been present or from a section in which Cottony Cushion Scale is known to have been generally distributed, except when treated as required by the Nursery Inspector, is hereby prohibited.

Rule 23‡. Any person or firm desiring to ship nursery stock into Florida shall file with the Nursery Inspector a satisfactory certificate of inspection. They will then be privileged to purchase Permit Certificate tags from the Florida Nursery Inspector. One, and only one, Permit Certificate tag shall be attached to each bundle of nursery stock shipped into Florida. Shipments shall be prepared and tags accounted for in accordance with the requirements of the Nursery Inspection Department of the State Plant Board of Florida.

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* Adopted February 14, 1916.
† Adopted February 14, 1916. Amended March 13, 1916.
† Adopted February 14, 1916. Amended March 13, 1916.
‡ Adopted April 10, 1916.

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Rule 24*. Persons or firms desiring certification of nursery stock shall file a request for inspection with the Nursery Inspector at Gainesville, at least sixty days in advance of the date upon which they desire to move or sell such nursery stock. Persons or firms requesting certification on shorter notice may be charged with the fee covering the expenses of inspection and certification as provided for in Section 9 of the Florida Plant Act of 1915.

Rule 25*. In order to prevent the introduction of the citrus disease known as citrus canker, the importation into Florida, of any and all kinds of citrus trees and parts thereof, including budwood and scions, and all other host plants of this disease as soon as discovered, except certain fruit intended for use as food products, is hereby prohibited. Provided, that importations of limited quantities of new or rare varieties may be allowed by special permit of the Plant Commissioner. Applications for such permits must be made to the Plant Commissioner, Gainesville, Florida.

Rule 26†. The importation into Florida of all trees, plants, vines, shrubs, cuttings, scions, leaves and parts of plants from The Bahamas, India and Jamaica, in which countries the spiny citrus white fly *(Aleurocanthus woglumi)* is known to occur, is hereby prohibited: provided, that this rule shall not be construed as prohibiting the importation of fruits and vegetables intended for use as food products when such fruits or vegetables are not infested or infected with any injurious insect or disease or the importation of which is not otherwise specifically prohibited: and provided, further, that this rule shall not prohibit the importation of lumber, logs, sisal hemp or manufactured articles.

Rule 27‡. The importation into the State of Florida of any and all of the following plants, plant products and stone and quarry products, originating in that portion of the New England states defined by the United States Department of Agriculture as being territory infested with the gypsy moth *(Porthetria dispar)*, is hereby prohibited, except that shipments of the things or articles herein enumerated may be admitted and permitted delivery in this State when accompanied by an inspection certificate (or permit) issued by a properly authorized agent of the United States Department of Agriculture or by the proper inspection official of the State in which such shipments originate, showing that they have been inspected and found free from the gypsy moth and the larvæ, pupæ and eggs thereof, and plainly labelled with the names and addresses of both consignor and consignee;

All trees, plants, shrubs, vines, cuttings, grafts, buds, and all other trees and plants, or parts thereof, commonly known as nursery stock.

All forest, fruit and ornamental trees and shrubs and parts thereof.

Field-grown florists stock, shrubs, vines, and all other plants or parts thereof for planting or propagation, except flower or vegetable seeds.

Forest-plant products, including logs, tan bark, posts, poles, railroad ties, cordwood, lumber, box-bands, and hoops.

Coniferous trees, such as spruce, fir, hemlock, pine, juniper, cedar and arbor vitæ, known and described as Christmas trees, and parts thereof.

Decorative plants, such as holly and laurel, known and described as Christmas greens or greenery.

Stone and all other quarry products.

Shipments of any of the articles aforesaid, originating at any point within the area defined by the United States Department of Agriculture as being infested by the gypsy moth, arriving at any port or other destination in the State of Florida without being accompanied by the certificate of inspection herein required, shall be subject to immediate deportation upon the order of the Plant Commissioner or his assistants, or otherwise treated as the Plant Commissioner may direct.

* Adopted April 10, 1916.
† Adopted June 5, 1916.
‡ Adopted Oct. 13, 1916.

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Rule 28*. The importation into the State of Florida of pineapple plants, slips, roots, fruits and all parts thereof, from Jamaica, in which country the Pineapple Black Weevil *(Metamasius ritchiei)* is known to exist, is hereby prohibited: provided, that this rule shall not prohibit the importation from Jamaica of canned pineapple or of processed pineapple juice.

Rule 29*. The movement of nursery stock from a nursery in which the Dictyospermum scale is known to have been present or from a section in which the Dictyospermum scale is known to exist except when treated as required by the Nursery Inspector is hereby prohibited.

Rule 30†. Whenever any authorized Inspector of the State Plant Board shall find in the possession of any common carrier in this State any shipment, article or product that is infected or infested with any insect, pest or disease, the dissemination of which, under the law or rules of this Board, now or hereafter promulgated, is or shall be prohibited, such common carrier shall make no further transportation or delivery of such shipment, article or product so infected or infested, otherwise than to return the same to the shipper, to be by him dealt with or treated as the law may provide. At the time of such inspection such inspector shall deliver to such common carrier a certificate in substantially the following form:

"To.....and All Whom It May Concern:
(Name of carrier)

"This is to certify that on the.....day of.....
19....., the undersigned inspected while in your possession at
....., Florida, a shipment of.....,
(Kind and nature)
consisting of.....bundles or packages, shipped by
..... of .....,
State of....., to....., at
....., State of Florida, and found the same to
be infected or infested with.....
(Name of insect pest or disease)

"And you are hereby notified that the transportation and delivery of said shipment so infected or infested, within the State of Florida, is prohibited by law and the Rules of the State Plant Board thereunder, except for the purpose of returning said shipment to the shipper, to be by him dealt with or treated as the law may require.

"This.....day of....., 19.....

.....
State Plant Board Inspector."

That the said Inspector shall at the same time attach to such shipment a duplicate of said Certificate.

It shall also be the duty of said Inspector to forthwith notify the consignee and consignor, if their names and addresses be known to such inspector, which notice shall contain in substance the information provided for in the foregoing form of certificate.

Rule 31‡. All inspectors employed by the State Plant Board shall be required to pass a written examination and to present satisfactory evidences of previous experience qualifying them for the particular duties for which they are employed.

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* Adopted Jan. 8, 1917.
† Adopted Feb. 12, 1917.
‡ Adopted April 9, 1917.

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ORDERS AND REGULATIONS OF THE POSTOFFICE DEPARTMENT RELATIVE TO PARCEL POST SHIPMENTS OF NURSERY STOCK AND CERTAIN OTHER PLANTS AND PLANT PRODUCTS

Nursery Stock—Not Admitted to Mails Unless Accompanied by Certificate of Inspection

Paragraph 2 of Section 478 of the Postal Laws and Regulations reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable, and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots, may be admitted to the mails only when accompanied by a certificate from a State or Government inspector to the effect that the nursery from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

Terminal Inspection of Plants and Plant Products Addressed to Florida Postoffices

The following Order was issued by W. J. Barrows, Act'g Third Asst. P. M. General, under date of October 24, 1916:

"OFFICE OF THIRD ASS'T P. M. GENERAL,
WASHINGTON, OCT. 24, 1916.

"The State of Florida has established a place for the terminal inspection of plants and plant products under the provisions of the Act of March 4, 1915, embodied in Section 478¼, Postal Laws and Regulations, appearing on page 49 of the May, 1915, Supplement to the Postal Guide.

"All postmasters are, therefore, informed that packages containing plants or plant products addressed to places in the State of Florida may be accepted for mailing only when plainly marked so that the contents may be readily ascertained by an inspection of the outside thereof. The law makes the failure so to mark such parcels an offense punishable by a fine of not more than $100.

"The plants and plant products subject to terminal inspection in the State of Florida are described as follows:

"'All trees, plants, shrubs, vines, cuttings, grafts, scions, buds, leaves, roots, fruit pits, and all other seeds of forest, fruit or ornamental trees or shrubs; all greenhouse, herbaceous and bedding plants and parts thereof; all blossoms or flowers of orange, lemon and other citrus plants; all fruits or nuts; all herbarium or dried specimens of plants or parts thereof, and other plants and plant products in the raw or unmanufactured state, except vegetable and flower seeds. *Provided*, That this list of plants and plant products shall not apply to plants and plant products shipped under the certificate of the Federal Horticultural Board of the U. S. Department of Agriculture, nor to plants and plant products originating in Florida and addressed to places in that State which are inclosed in packages plainly marked to show the nature of the contents and accompanied with the certificate from the Florida State Plant Board or its duly authorized inspectors embodying the information prescribed by paragraph 2, Section 478, Postal Laws and Regulations.'

"Postmasters within the State of Florida shall be governed strictly by the provisions of paragraphs 3, 4, 5, and 6, Section 478¼,

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Postal Laws and Regulations, in the treatment of all packages addressed for delivery at their offices containing any plants or plant products above described as subject to terminal inspection.

"Inspection service is maintained at Gainesville, Fla., and all postmasters in that State shall send to that place for inspection after receiving the required postage therefor, under the provisions of Section 478¼, Postal Laws and Regulations, each package containing plants or plant products subject to terminal inspection.

"Owing to the perishable character of plants and plant products, the packages containing such matter must be given prompt attention.

"Any failure of compliance with the foregoing instructions or with the provisions of Section 478¼, Postal Laws and Regulations, coming to the attention of any postmaster should be reported to the Third Assistant Postmaster General, Division of Classification.

"W. J. BARROWS,
"Act'g Third Ass't P. M. Gen."

Section 478¼ P. L. & R.

Section 478¼ of the Postal Laws and Regulations, under authority of which the above Order is issued, and which is referred to therein, reads as follows:

"Sec. 478¼. *(a)* When any State shall provide for terminal inspection of plants and plant products, and shall establish and maintain, at the sole expense of the State, such inspection at one or more places therein, the proper officials of said State may submit to the Secretary of Agriculture a list of plants and plant products and the plant pests transmitted thereby, that in the opinion of said officials should be subject to terminal inspection in order to prevent the introduction or disseminaion in said State of pests injurious to agriculture. Upon his approval of said list, in whole or in part, the Secretary of Agriculture shall transmit the same to the Postmaster General, and thereafter all packages containing any plants or plant products named in said approved lists shall, upon payment of postage therefor, be forwarded by the postmaster at the destination of said package to the proper State official at the nearest place where inspection is maintained. If the plant or plant products are found upon inspection to be free from injurious pests, or if infected shall be disinfected by said official, they shall upon payment of postage therefor be returned to the postmaster at the place of inspection to be forwarded to the person to whom they are addressed; but if found to be infected with injurious pests and incapable of satisfactory disinfection the State inspector shall so notify the postmaster at the place of inspection, who shall promptly notify the sender of said plants or plant products that they will be returned to him upon his request and at his expense, or in default of such request that they will be turned over to the State authorities for destruction. (Act of March 4, 1915.)

"*(b)* It shall be unlawful for any person, firm, or corporation to deposit in the United States mails any package containing any plant or plant product addressed to any place within a State maintaining inspection thereof, as herein defined, without plainly marking the package so that its contents may be readily ascertained by an inspection of the outside thereof. Whoever shall fail to so mark said packages shall be punished by a fine of not more than $100. (Act of March 4, 1915.)

"*(c)* The Postmaster General is hereby authorized and directed to make all needful rules and regulations for carrying out the purposes hereof. (Act of March 4, 1915.)

"2. When the Secretary of Agriculture furnishes the Postmaster General a list of plants and plant products subject to ter-

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minal inspection under the provisions of the preceding paragraph, appropriate instructions in regard thereto shall be issued to postmasters by the Third Assistant Postmaster General, Division of Classification.

"3. When a package containing plants or plant products subject to terminal inspection is received at the post office of address, the postmaster shall at once notify the addressee of the required amount of postage for forwarding it to the place of inspection and return. Upon payment of the required amount, the postmaster shall affix to the parcel stamps sufficient to cover the postage from his office to the place of inspection, and place in an official envelope, to be attached to the parcel and addressed to the postmaster at the place of inspection, the stamps representing the amount of postage furnished by the addressee for its return. The postmaster shall then indorse on the wrapper of the parcel the words, "Forward to ....., for inspection," and transmit
(Give postoffice of inspection)
the parcel to the postmaster at the place of inspection.

"4. *(a)* On receipt of the parcel at the post office of inspection the postmaster shall deliver it to the proper State official, and if such official shall return it to him marked to show that it has been inspected and passed, the postmaster shall affix to the parcel the postage furnished for returning it to the post office of address and promptly transmit it to that office. It shall then be delivered to the addressee.

"*(b)* If the State official to whom a parcel containing plants or plant products has been sent for inspection shall inform the postmaster at the place of inspection that such plants or plant products are infected with injurious pests and incapable of satisfactory disinfection, the postmaster shall promptly notify the sender that the parcel is undeliverable, giving the reason therefor together with the name and address of the addressee, and stating the amount of postage required for its return and that if the postage is not promptly furnished the parcel will be turned over to the State authorities for destruction. After the sending of such notice, the postmaster shall wait the length of time prescribed in paragraph 8, Section 637, when, if postage be not received by that time, he shall inform the State authorities that the parcel may be destroyed by them.

"5. When a parcel containing plants or plant products is returned to the sender or destroyed under the provisions of the preceding paragraph, the postage stamps representing the amount of postage furnished by the addressee for the return of such parcel from the post office of inspection to the office of address shall be sent by the postmaster at the former office to the addressee together with a letter of information as to the disposition of the parcel.

"6. If the addressee, after having been notified, as prescribed in paragraph 3 of this section, fails to furnish the required postage for sending the parcel to the place of inspection and return, the postmaster shall so notify the State Inspector at that place and advise him of the amount of postage required for sending the parcel to him. If such official furnishes the postage the postmaster shall, after affixing the necessary stamps, indorse on the wrapper of the parcel the words 'Forward to.....
(Give postoffice of inspection)
for inspection,' together with the words 'Postage paid by State,' and transmit it to the postmaster at the place of inspection. If the State Inspector shall return the parcel to the postmaster at the point of inspection, marked to show that it has been inspected and passed, and having postage properly prepaid, it shall be transmitted to the office of address and delivered to addressee. Should the State Inspector fail to furnish the postage for sending the parcel to him

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for inspection, the parcel shall be treated as other undeliverable fourth-class matter, as prescribed in Section 637."

Summary

Under the provisions of the foregoing Order of the Third Asst. P. M. General, and under the sections of the Postal Laws and Regulations referred to:

All packages of plants and plant products tendered for mailing to points in Florida must be plainly labelled to show the nature of the contents.

A list of the various plants and plant products subject to inspection is given in the Order quoted above.

Parcel-post packages of plants and plant products, originating in Florida, bearing the inspection certificate tag of *the State Plant Board of Florida*, when addressed to Florida points, may be sent direct to addressee: namely; such packages do not have to be sent to the postoffice at Gainesville, Florida, for inspection.

Parcel-post packages of plants and plant products, regardless of State of origin, bearing the inspection certificate of *the Federal Horticultural Board*, U. S. Dept. of Agriculture, may also be sent direct to addressee.

Packages of plants or plant products (except vegetable and flower seeds), addressed to post offices in Florida, not accompanied by the inspection certificate of the Federal Horticultural Board, are required sent by the postmaster at office of address to the post office at Gainesville, Fla., for inspection by the State Plant Board, the postage thereon to be furnished by the addressee.

All packages of plants and plant products (except vegetable and flower seeds) from other States addressed to post offices in Florida, not accompanied by the inspection certificate of the Federal Horticultural Board, are required sent to the Gainesville post office for inspection.

An inspection certificate issued by the State officials of any State other than Florida does not entitle plants or plant products to delivery in Florida without being subjected to terminal inspection.

"Florida Permit Tags," accompanying mail shipments of plants or plant products, originating in another State, addressed to Florida post offices, do not exempt such shipments from the requirements of the Orders and Sections quoted above: namely, such shipments are subject to terminal inspection.

Mail shipments of plants and plant products, originating in Florida, but addressed to post offices in other States, are not required sent to the Gainesville post office for inspection. However, Paragraph 2 of Section 478, P. L. and R., quoted above, requires that all mail shipments of *nursery stock* (regardless of destination) shall have an official certificate of inspection attached when tendered for mailing.

Mail Shipments from Foreign Countries

> "A postoffice order dated May 27, 1913, as amended December 16, 1913, prohibits the importation by mail of all growing or living plants, seeds, and other plant products for propagation, except field, vegetable, and flower seeds."*†

With reference to the treatment by postmasters of prohibited nursery stock received from foreign countries the Second Assistant Postmaster General issued the following Order under date of June 1, 1915:

> "This Department and the Department of Agriculture are in receipt frequently, both directly and through postmasters, of re-

* U. S. Department of Agriculture, Federal Horticultural Board, Service and Regulatory Announcements, April 1916, page 46.

† Parties desiring to import plants from foreign countries, through channels other than the mails, should apply to the Federal Horticultural Board, Washington, D. C., for a permit under the Plant Quarantine Act of August 20, 1912, as amended March 4, 1913.

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quests from importers of nursery stock that delivery be authorized of certain mail shipments of prohibited plants or plant products. It is understood that pending the receipt by such importers of replies to their requests, the shipments in question are withheld from return by postmasters notwithstanding the instructions of the Department that all packages of prohibited nursery stock received in the mails from abroad shall be appropriately indorsed and returned to origin immediately.

"Postmasters are enjoined, therefore, to comply strictly with the instructions referred to by declining to withhold from return any prohibited nursery stock in order to afford an opportunity to the importer to communicate with the Department with the view of having an exception made in any particular case.

"The term 'nursery stock' as applied to the prohibition in question includes all growing or living plants, seeds and other plant products, for propagation, except field, vegetable and flower seeds. It includes also bulbs, roots and tubers and, with the exceptions noted, the seeds of all trees, shrubs or other plants. The only plants or plant products excepted from the prohibition are those ordered by, or intended for, and addressed to the 'Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, Washington, D. C.'

"In this connection, reference is had to the notice of this office printed on page 2 of the Postal Guide (supplement) for January, 1914, and to the notice on pages 129 and 130 of the Postal Guide for July, 1914.

"The widest possible publicity should be given to this notice."

The above information is published for the information of employees of the State Plant Board of Florida, nurserymen and other shippers of plants and plant products. Postmasters receive their instructions relative to the above from the Post Office Department.

WILMON NEWELL,
Plant Commissioner.

Gainesville, Fla.,
April 14, 1917.

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JULY, 1917

Vol. I

THE QUARTERLY BULL

OF THE

STATE PLANT BOARD

OF FLORIDA

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. 1 JULY, 1917 No. 4

FLORIDA AND THE MEDITERRANEAN FRUIT FLY

By

E. A. BACK

Bureau of Entomology

With the passage of the Federal Plant Quarantine Act of 1912, there was made possible the first serious attempt in this country to prevent further introduction of insect and plant dis-

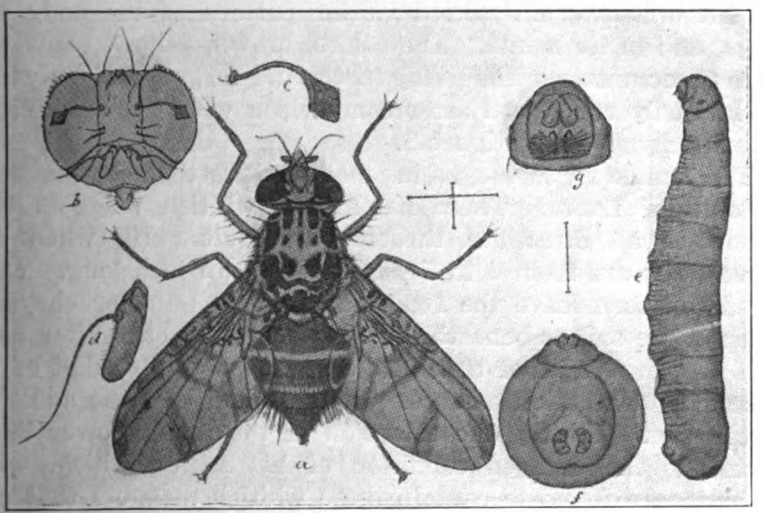

Fig. 3.—The Mediterranean fruit fly *(Ceratitis capitata)*: *a*, adult fly; *b*, head of same from front; *c*, spatula-like hair from face of male; *d*, antenna; *e*, larva; *f*, anal segment of same; *g*, head of same. *a* and *e*, enlarged; *b*, *g*, *f*, greatly enlarged; *c*, *d*, still more greatly enlarged. (From Howard, U. S. Dept. of Agriculture.)

eases from foreign countries. Along with the issuing of quarantines, the Federal Horticultural Board has been accumulating information regarding pests that will be injurious should they become established in the United States. Had such investigations been started years ago, Florida would now be free from such troubles as the citrus and the cloudy winged white flies *(D. citri* and *citrifolii)* and the citrus canker *(Pseudomonas citri)*, all of which could have been eliminated easily, either at the ports of entry, or in the quarantine greenhouses of the Department of Agriculture at Washington. With the efforts of

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the State Plant Board of Florida added to those of the Federal Horticultural Board, it is hoped that Florida will be kept free from the ravages of a number of well-known pests causing damage elsewhere. Among these pests is the Mediterranean fruit fly *(Ceratitis capitata)*, one of the worst enemies to fruits in general, that occurs in the tropical and semi-tropical countries, and one which will become established on the mainland of the United States in the not distant future unless quarantine officials are able to successfully intercept it.

What is the Fruit Fly Like?

The Mediterranean fruit fly is an insect which in the adult state resembles in size and general shape the ordinary house fly, but differs greatly in the color pattern of the body and wings, and in its habits. The colors, brown, yellow, black and white predominate in the living insect and form a pattern which can be easily recognized after comparison with the drawing of the adult fly given in Figure 3.

The female fly lays eggs in small cavities that she makes in the skin of fruits. These hatch into whitish maggots that burrow in all directions through the fruit until, when full grown, they are from 4 to 5 sixteenths of an inch long. (Fig. 3.) They then leave the fruit and form a pupa or chrysalis either in the soil or beneath any sheltering object. After passing a varying length of time in the pupal stage, the adult of the succeeding generation emerges. It is seldom that the adult fly is seen first. Usually the attention of the fruit grower is attracted to the decayed condition of his fruits, which, when cut open, are found to contain these whitish maggots that curl up and jump short distances when taken out of the fruit and placed upon a table. Maggots found in fruits which resemble the general description given—particularly as to size and the jumping habit—should be placed immediately in alcohol and sent with an explanatory letter to the State Plant Board at Gainesville so that an investigation to prevent a spread may be inaugurated without delay.

Fruits and Vegetables Attacked

The Mediterranean fruit fly is particularly injurious because it attacks many different kinds of fruits, nuts and vegetables. In the Hawaiian Islands, 72 kinds of fruits have been found infested. As the complete list will be available soon in bulletin form, it is not given here. It may be said, however, that almost any fruit in the Hawaiian Islands may harbor larvae of the

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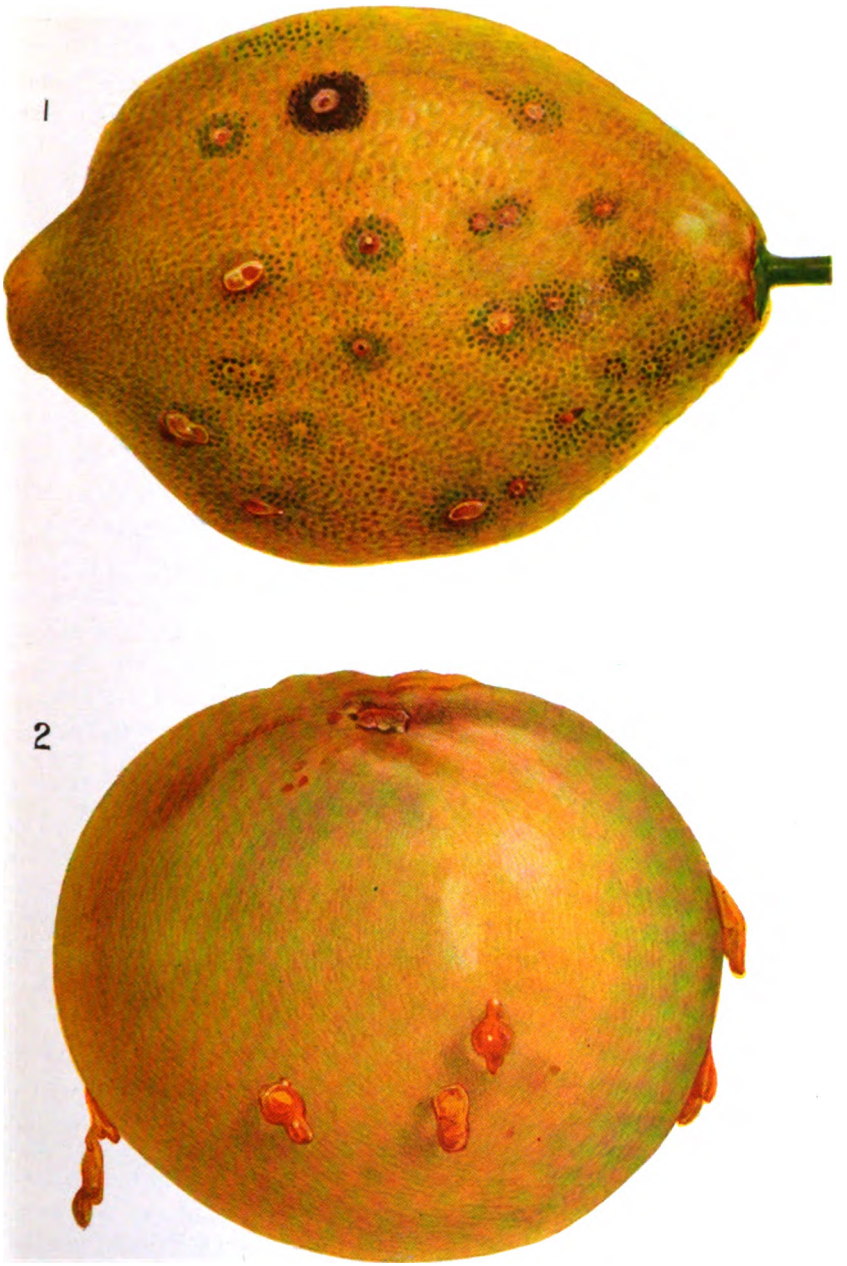

Plate XXIV.—Damage by Mediterranean Fruit Fly. 1, Hawaiian-grown lemon of commercial type. While discoloration does not always follow the puncturing of the rind, such disfigurations as shown are not unusual in Hawaii where infestation is excessive. Note the globules of gummy secretions accumulating about certain punctions; they may not occur, or they may take the form of slender spiral threads. Lemons may sometimes be infested in the rind without giving an external evidence to the student. 2, Ripe grapefruit, showing the copious gummy secretions that may, though more often do not, follow attack.

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fruit fly, even though it be the nut of a palm, the berry of an ornamental shrub, or the edible fruit of some well-known commercial species. A partial list of host fruits contains oranges, grapefruit, lemons, limes, kumquats, tangerines, peaches, apples, figs, apricots, bananas, mangoes, avocadoes, sapotas, loquats, persimmons, guavas, quinces, papayas or pawpaws, pears, plums, grapes, eggplant, tomatoes, and even cotton bolls. Of these the eggplant, grapes, and cotton bolls are but slightly affected even under conditions most favorable to the fruit fly, and pawpaws and bananas become infested only if left upon the plants until they are very ripe. The berries of the umbrella or china-berry tree *(Melia azodarach)* and strawberries are not affected.

North America Alone Free From Infestation

The Mediterranean fruit fly has been known to science for 100 years. During these years it has been spreading throughout the world until at present the North American continent is the only large land area upon which it has not become established. It first attracted serious attention in London where it was found that oranges arriving there from the Azores, Canary, Cape Verde and Madeira Islands were badly decayed and wormy. It was recorded as a pest in Spain in 1842, in Algeria in 1858, in Italy in 1863, in Sicily in 1878, and in Tunis in 1885. In 1889 it was causing damage in South Africa. It became established in Western Australia in 1897, and in the eastern part of Australia in 1898. In 1899 it was detected in Tasmania; in 1900 it was found in orchards near Paris, France, and during 1901 it was reported from New Zealand and Brazil. Compere, in 1904, found the pest in Egypt and in Asiatic Turkey at Beirut, Jappa and Jerusalem. Argentina was reported infested in 1905. During 1916 the orange, tangerine, peach, pear, and apple crop of the Patras consular district of Greece was badly damaged. Between 1909 and 1914 it was found in the eastern and western portions of Africa. It was first found in the Hawaiian Island at Honolulu in 1910 and within two years had spread to every important island of this group. The Bermuda Islands have been infested since 1865. Reports that the Mediterranean fruit fly is established in the West Indies are unwarranted from our present information.

Known Instances of Artificial Dissemination

The fruit fly was established in many of the countries listed above at the time entomologists made their first surveys, hence

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the dates of the first report of the insect from certain of the countries, as for instance, Spain, Italy and western Africa, do not necessarily establish a truthful chronology of spread. In fact, the west African coast region is considered the original home of the pest although it was among the last places to be found infested. To men in an uninfested country like the United States, the known instances of spread and establishment are serviceable in pointing out the avenues of spread that must be particularly guarded against.

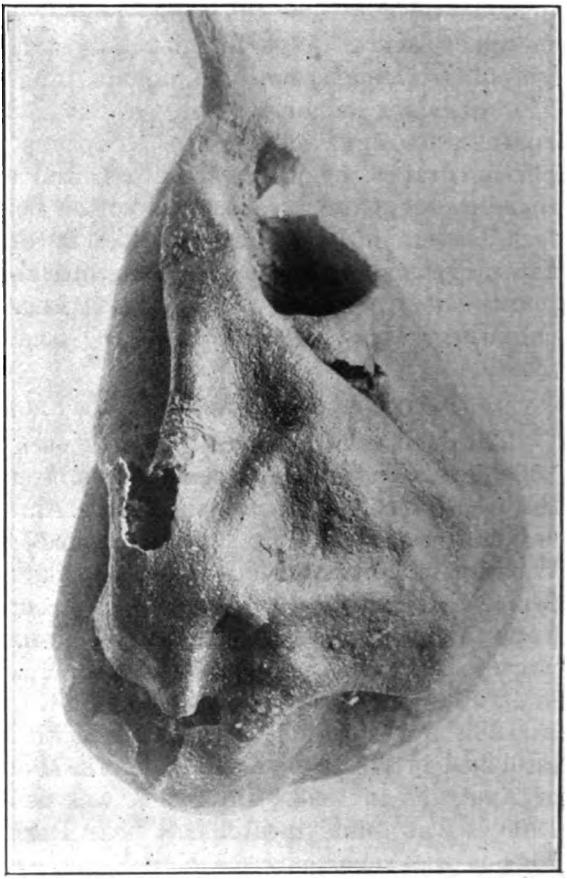

Fig. 4.—Bartlett pear, the interior of which has been entirely consumed by the larvae of the Mediterranean fruit fly. (From U. S. Dept. of Agriculture.)

The spread of the fruit fly to the eastern and western portions of Australia and to Brazil is the direct result of the development of rapid ocean transportation and cold storage which made possible the development of an export trade in citrus fruits from the infested Mediterranean region to these countries, although Brazil may have become infested via South Africa. The establishment in Hawaii at Honolulu was a sequence to the establishment in eastern Australia and was made possible by vessels plying between Australian and American and Canadian ports. It is reported that Bermuda became infested in 1865 when a vessel, bound for New York from the Mediterranean region, was blown out of its course and forced to unload its cargo containing infested fruits at St. George.

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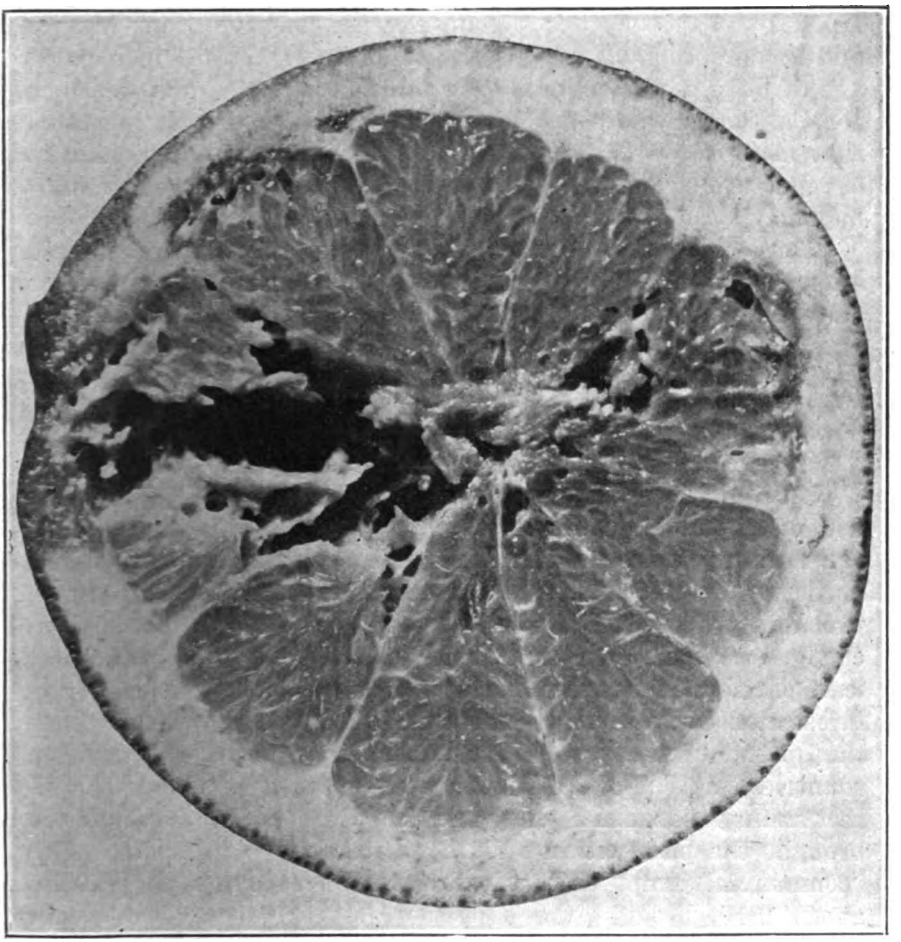

Fig. 5.—Grapefruit, showing destructive work of Mediterranean fruit fly larvae in the pulp. (From U. S. Dept. of Agriculture.)

A fruit fly pupa was discovered in New Zealand in soil about the roots of a plant imported from Australia, and in Tasmania infested fruits from Sydney are frequently condemned. In 1909, a case of peaches infested with living larvae arrived at Auckland, New Zealand, after a four-week voyage in cold storage from Cape Colony. At San Francisco, inspectors of the Federal Horticultural Board and of the California State Commission of Horticulture are almost monthly intercepting infested fruits in the ships' stores and even in the baggage and pockets of tourists returning from Honolulu. At Washington, the Federal Horticultural Board has found a living pupa of the papaya

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fruit fly *(T. curvicauda)* in an express package from Mexico and living specimens of the olive fruit fly *(D. oleae)* in a package of olive seed sent by mail from South Africa and destined for California where the olive fly does not occur. It is stated that many fruit fly larvae are found in London each year in oranges from Spain, imported for the manufacture of marmalade.

These are but a few of the definite instances of spread known to have occurred, yet they indicate that it is not idle to state that the Mediterranean fruit fly is nearer making a conquest of the best citrus regions of the world today than it has ever been before.

Obstacles in Way of Establishment in America

On the West

Until 1897, the Pacific Coast of North America was in no danger of becoming infested from the West by the Mediterranean fruit fly, since at that time only the countries and islands bordering on the Mediterranean Sea, Africa in general (in all probability) and the Bermudas were infested. Hence ships engaged in trade upon the Pacific and touching at North American ports plied between ports not only themselves free from infestation, but also very remote from infested countries. With the spread of the pest to Australia, from the Mediterranean countries, in 1897-8, the situation at once was changed, for direct sailings between Sydney and San Francisco and Vancouver brought the pest within striking distance of California. The "commercial jump" of the fruit fly from Australia to Hawaii, about 1910, brought the danger of establishment two weeks nearer to California ports. With the fruits of the Hawaiian Islands now thoroughly infested (except pineapples and commercial shipments of bananas), the great development in the tourist travel between the Islands and the mainland, the lowering of the sailing time between Honolulu and Hilo and San Francisco to 4½-7 days, and with the making of San Pedro a port of call for ships from Hawaii during a portion of the year, the opportunities for establishment in California have been greatly increased during the past five years. Only the untiring efforts of the quarantine officials of the Pacific Coast ports, working in cooperation with the Federal Horticultural Board, and assisted by unfavorable climatic and host conditions surrounding the docks at San Francisco, can keep the pest from gaining a foot hold on the Pacific Slope. Those who doubt this

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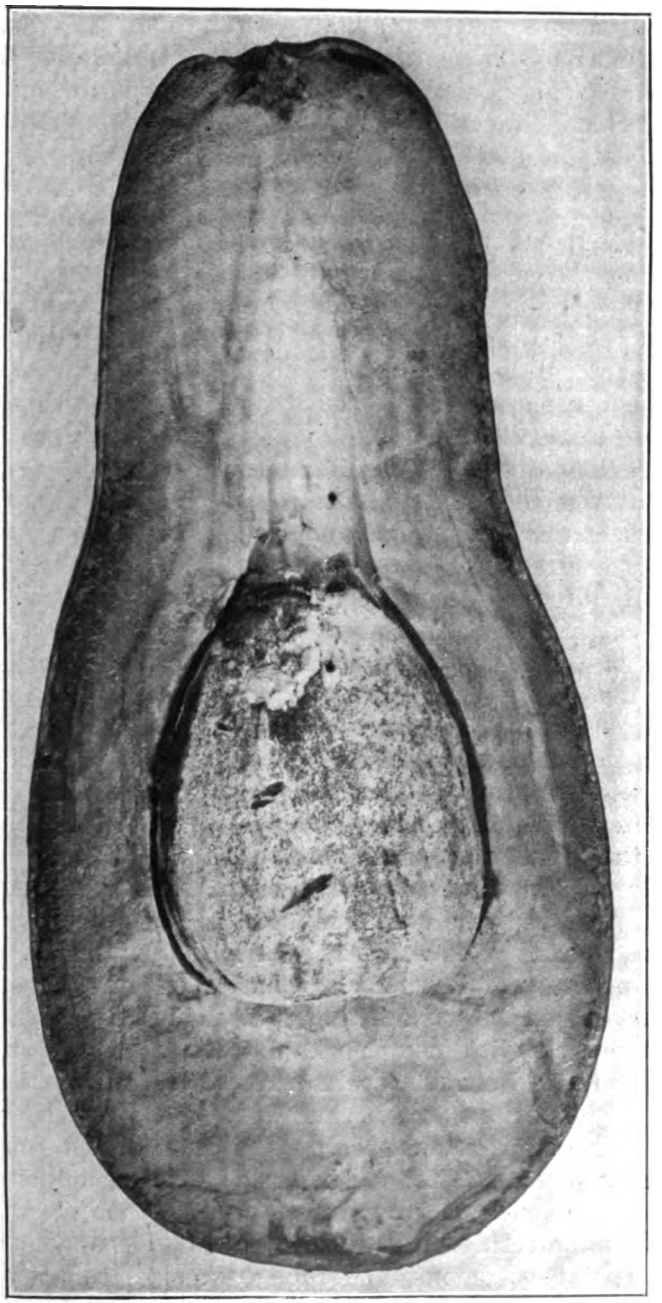

Fig. 6.—Cross section of avocado showing injury to pulp at both stem and blossom ends by Mediterranean fruit fly larvae. (From U. S. Dept. of Agriculture.)

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statement should become familiar with the fruit fly situation in Hawaii and read the monthly reports of the Quarantine Division of the California State Commission of Horticulture and of the Federal Horticultural Board. The Mediterranean fruit fly is knocking at the gates of California almost monthly.

On the East

Three important factors have worked to prevent establishment along the eastern seaboard of the United States. They are checks developing out of trade and climatic conditions and the host relationships of the fruit fly. The infestation of Bermuda is the result of an unforeseen disaster at sea, as already mentioned, which put the fly ashore in a favorable climate.

Trade Conditions. Aside from lemons and grapes, the infested regions about the Mediterranean Sea export practically no fresh fruit to America. Comparatively small quantities of non-citrus fruits, except figs and grapes, are grown and those that escape attack find a ready market in Europe. Such small shipments of fresh figs, prickly pears, etc., shipped to the United States during short seasons are absorbed by the Latin colonies of larger northern cities, especially New York. Even during the past winter, when the northern European markets were largely closed to Spanish oranges because of the war, these fruits could not be profitably placed upon the New York market in competition with the Florida and California crop. In fact, the citrus crop of these two states has indirectly been for years one of the greatest trade barriers to the establishment of the fruit fly on American soil, for they have usurped the orange market, thus making shipments of Mediterranean fruits to America, outside of New York, generally unprofitable.

The nearness of Bermuda to Charleston and our southeastern coast is not the menace that it would be if its trade were not carried on with new York and England. Fresh native grown fruits in Bermuda are a rarity. The bulk of her fresh fruits are American grown and imported from New York. Fresh Bermuda vegetables shipped to the United States can only be exported profitably during the winter months and before our own southern grown truck crops can be placed on the market in competition. Furthermore, the Bermuda crops exported (potatoes, onions, and foliage crops) are not attacked by the fruit fly, and all are consumed in New York.

Host Relationships. The host relationships of the fruit fly have played their part in serving as barriers to establishment in

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America. The list of fruits and vegetations subject to attack has been shown to be large, yet the number of cultivated edible fruits infested and grown in quantities sufficiently large in the Mediterranean regions to reach beyond local markets, is very small, and as far as American territory, outside of New York, is concerned, is limited to Malaga grapes and lemons. None of the host fruits are so rare as to warrant their being carried across the ocean as curiosities by tourists as is true of many fruits grown in the Pacific regions. Fortunately, Malaga grapes and lemons have been found to be as free from danger as carriers of the pest as any ordinary articles entering into transatlantic trade. This conclusion is the result of studies made by Prof. H. J. Quayle in the citrus orchards and in the curing and packing houses of Italy, Sicily, and Spain, and by agents of the Bureau of Entomology in Hawaii, supplemented by a painstaking examination by the writer of many consignments of fresh lemons arriving at the port of New York during Nov.-Dec. 1913. During the past harvesting season for Malaga grapes in Spain, the writer was authorized by the Federal Bureau to make observations in the principal Spanish grape growing regions, but found no infestations although the markets of Cadiz, Seville, Granada, Valencia, Alicante, Barcelona, Madrid, and Zaragoza were examined. Exception must be made of one instance in which a single berry out of 1,000 decaying berries in the market of Cadiz was found to contain a larva. This single infestation appeared to be of a secondary nature. Had grapes and lemons, in commercial shipments, been generally infested, larvae would have been found years ago in imported fruits. For those wishing detailed results of experimental work bearing upon the infestation of citrus fruits, there has been accumulated by the Bureau of Entomology much information that can be had on application.

Climatic checks. Adverse climatic conditions have played an important part in preventing establishment. Experiments conducted by the Bureau of Entomology in Hawaii, and observations made by the writer in Spain, indicate that the Mediterranean fruit fly will not be a pest, except possibly in late peaches, when the monthly mean temperatures fall to or slightly below 50° F. for three consecutive months during the year. In the Hawaiian Islands where climatic conditions are nearly ideal for fruit fly increase, development progresses most rapidly after the daily means reach about 78-79° F. and is about doubled

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when these fall to 68° F. No development occurs after the temperature falls below 50° F. and complete mortality follows if the fly is subjected to this temperature sufficiently long. An exposure of 2 to 3 weeks to 32° F. will kill all stages of the fruit fly. It is, therefore, evident that any fruit flies arriving in the northern markets would be speedily killed during the winter months or be forced to die within warehouses and stores. Even should importations of fruit yield flies during the summer months when the temperatures are not fatal, death would follow under city conditions, such as those of New York, for the adult flies cannot live more than 3 to 4 days without food, and, unaided, do not fly any distance from the point of emergence.

Greatest Danger from West Indies

While there are weaknesses in the argument concerning the natural barriers to the infestation of the eastern seaboard by the Mediterranean fruit fly, it contains enough of truth to strengthen the belief of the writer that Florida's chief source of danger from infestation today lies in the direction of the West Indies. At present, the islands of the Caribbean Sea are not known to be infested by the Mediterranean fruit fly. With the opening of the Panama Canal, cargoes have been and will be shipped from Honolulu to the East, and from Australia. Spanish boats have been plying between Spain and West Indian and Mexican ports, and even Galveston and New Orleans. The fruit fly is well established in Brazil, and is said to be in Argentina. There is danger that coast-wise trading vessels will spread the infestation northward if they have not already done so. The development of trade between North and South America will increase the opportunities for spread. Mr. C. L. Marlatt, Chairman of the Federal Horticultural Board, has already planned an investigation of the sources of danger in the West Indian region that immediately concerns Florida and the Gulf States.

The Mediterranean Fruit Fly Can Thrive in Florida

After nearly four years' experience with the fruit fly in various climates of the Hawaiian Islands, and after personally investigating fruit fly conditions in Bermuda and Spain, the writer does not hesitate to say that the Mediterranean fruit fly is capable of becoming a most serious pest in any part of Florida so far as the climate is concerned.

In Table I are given the monthly mean temperatures, accompanied in most instances by the means of the maxima and

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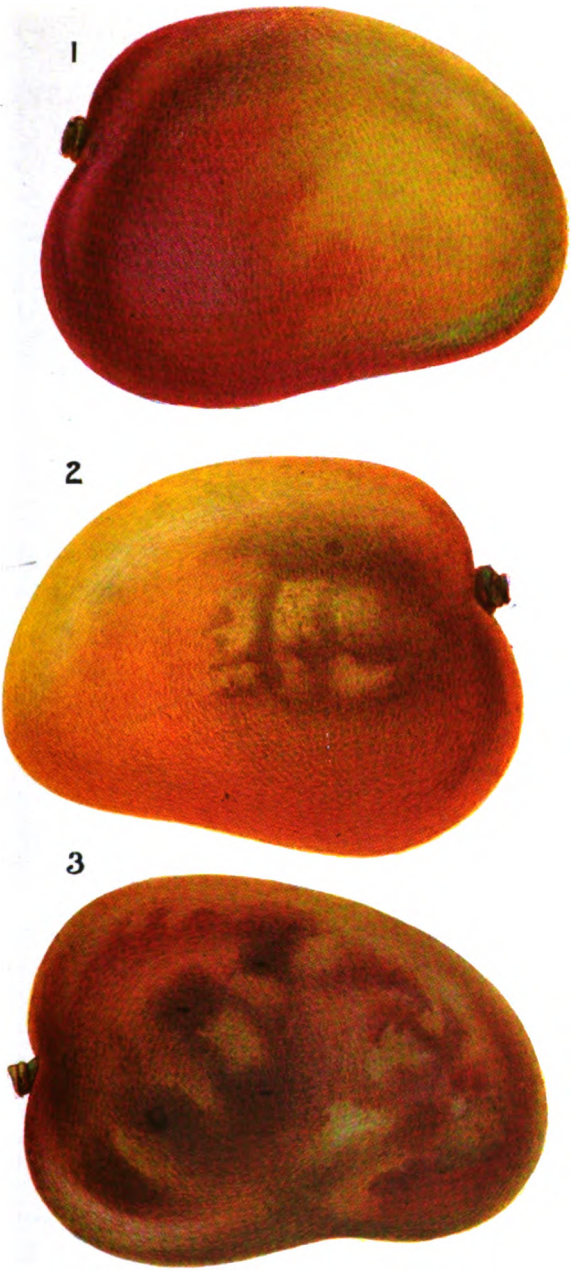

Plate XXV.—Mangoes and the Mediterranean Fruit Fly. Mangoes, particularly the seedling sweet mangoes, are favorite hosts of the Mediterranean fruit fly. Above are shown three fruits in various stages of infestation. 1. A ripe fruit containing eggs of the fruit fly. The breaks in the skin through which the eggs have been laid are so small that they are not to be seen except by the trained eye, hence the fruit appears uninfested. After the larvae hatch and begin to burrow about in the pulp beneath the skin, they cause decay to set in and these decayed spots, showing dark colored through the skin, give evidence of the destruction caused by the larvae. 2, A fruit in which the larvae are still young. 3, A fruit in which the larvae are well grown and have caused much damage.

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Fig. 7.—Mango, cut open to reveal cavities made in the pulp by larvae of the Mediterranean fruit fly. In upper left-hand side can be seen a cavity containing the whitish eggs deposited by the adult female. (From U. S. Dept. of Agriculture.)

minima temperatures, for Barcelona, Valencia, Zaragoza, and Cordoba, Spain, of Key West, Miami, Ft. Myers, Bartow, Eustis and Tallahassee, Florida, and of Bermuda.

At Barcelona during the last October the writer found practically all the late peaches on the market infested, and the Japanese persimmons, apples and very many of the earlier ripening oranges upon the trees, both within the city limits and in the neighboring farming districts, quite generally attacked. At Va-

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lencia, Japanese persimmons, quinces, and a few apples were infested while practically all of the earlier ripening and highly colored oranges bore fruit fly punctures. However the bulk of the citrus crop about Valencia which had not then (November) turned a deep color, was free from attack. At Zaragoza, only late peaches were found infested; excellent apples and quinces, said to have been grown just outside of the city, were free from infestations or deformities resulting from fruit fly attack. Quinces grown in the region of Cordoba were badly infested—not a single uninfested fruit was found—and practically all the apples from near this place, in the markets of Cadiz during late November, showed evidence of attack, though comparatively few contained larvae.

It has already been stated that the fruit fly develops most rapidly after the daily means rise to 78°-79° F. In Honolulu, when the temperature is about 79° F., the immature stages may be completed in as few as 13, or as many as 33 days, according to the individual and its host, although the largest number become adult in from 18 to 20 days. The developmental period for the immature stages is about doubled when the monthly mean drops to 68° F., while practically no development occurs at 50° F. and no development below this point. Yet, the fruit fly can withstand lower temperatures for varying lengths of time. Thus, 62 of 248 larvae lived through an exposure of 21°-28° F. for 5 days, or a period fatal to most of Florida's crops. An exposure to an even temperature of 32° F. for 4 days had little effect upon larvae infesting apples. Development proceeds, though slowly, at temperatures between 52°-58° F. In Hawaii, in fruit-growing districts where the winter monthly means drop to about 68° F., the fruit fly is a serious pest. Additional data may be had upon the effect of low temperatures upon the fruit fly on application to the Bureau of Entomology. Bearing in mind the statements regarding infestation, given above, a comparison of the temperature means, in Table I, of the Spanish and Florida districts, leaves no doubt that the fruit fly will maintain itself easily under Florida climatic conditions.

Conclusion

While conditions in the past have not favored the establishment of the Mediterranean fruit fly in California and the Gulf Coast States, the opportunities for spread to these states have been greatly increased during the past few years. With the spread of the pest to the Hawaiian Islands in 1910, infested

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fruits have been intercepted and condemned at the port of San Francisco on an average of about once a month.

Florida's greatest danger of infestation appears to lie in the direction of the West Indies, since with the opening of the Panama Canal and the development of trade between North and South America, this is the region through which pass vessels from Hawaii, Australia, Brazil, Argentina, and the Mediterranean countries—countries all now infested. There is every reason to believe that the Mediterranean fruit fly will become a serious and ever present pest if once established in Florida. While climatic conditions are favorable to its increase, the dearth of native or wild host fruits will make possible a successful, though very troublesome, campaign for its subjugation.

TABLE I.—Containing the monthly mean temperatures, with the mean of maxima and minima temperatures, of points in Spain, Florida and Bermuda infested by the Mediterranean fruit fly.*

Locality	Mean of	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Barcelona	maxima	55	57	60	64	70	79	81	84	78	75	64	59
	minima	40	39	42	46	53	60	64	67	61	56	48	44
Valencia	maxima	51	55	58	59	65	70	73	77	73	65	58	53
	minima	45	50	52	56	62	66	69	74	62	63	55	50
	monthly	50	52	55	59	64	70	76	77	72	65	57	51
Zaragoza	maxima	46	58	63	69	72	76	82	84	81	69	56	51
	minima	30	41	43	47	52	55	60	61	56	50	39	37
	monthly	38	49	53	58	62	66	71	73	69	59	47	44
Cordoba	maxima	54	60	65	71	77	83	93	96	92	76	62	56
	minima	36	43	45	50	54	57	65	66	64	55	46	44
	monthly	45	51	55	61	65	70	79	81	78	65	54	50
Key West	maxima	74	76	77	80	84	87	89	89	87	83	78	74
	minima	65	67	68	71	75	78	79	79	78	75	71	66
	monthly	70	71	73	76	79	82	84	84	85	79	74	70
Miami	maxima	74	76	80	82	86	89	89	90	88	84	80	76
	minima	57	59	64	64	69	74	76	75	74	71	67	61
	monthly	65	67	71	74	76	81	82	82	81	78	74	69
Ft. Myers	maxima	72	74	79	82	86	88	88	88	86	82	77	72
	minima	52	54	58	61	66	71	73	74	73	68	61	55
	monthly	62	65	68	72	77	80	81	81	80	75	70	64
Eustis	maxima	69	71	77	82	89	91	92	92	89	83	76	70
	minima	48	50	54	59	56	71	74	73	72	64	56	50
	monthly	58	61	67	70	77	81	83	83	80	73	66	60
Tallahassee	maxima	60	63	71	77	85	88	88	87	85	76	68	62
	minima	42	44	51	56	64	70	72	72	69	60	50	44
	monthly	52	55	60	67	75	79	80	80	77	68	59	53
Bermuda	monthly	62	62	64	66	71	78	80	81	78	74	69	65

*Temperatures are for following periods: Barcelona, 10 years; Valencia, monthly means, 30 years; Zaragoza and Cordoba, for 1914; Bermuda, 4 years; Florida points, 10 to 30 years.

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DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING JUNE 30, 1917

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending June 30th, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING JUNE 30, 1917

Citrus grove trees inspected	4,476,804
Citrus nursery trees inspected	18,557,736
Inspectors employed	363
New properties showing infection	12
Total properties showing active infection	33
Grove trees found infected	266
Nursery trees found infected	26
Counties in which active infections were found	7

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,629
Nursery trees found infected since May, 1914	342,254
Number properties infected to June 30, 1917	454
Properties declared no longer "danger centers"	338
Properties still classed as "infected" June 30, 1917	116

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1917:

1914		1915		1916		1917	
		Jan.	306	Jan.	86	Jan.	14
		Feb.	165	Feb.	21	Feb.	4
		Mar.	444	Mar.	49	Mar.	9
		Arpil	408	April	49	April	169
May	108	May	1042	May	338	May	52
June	160	June	772	June	450	June	45
July	275	July	651	July	349		
Aug.	1313	Aug.	1345	Aug.	219		
Sept.	767	Sept.	618	Sept.	124		
Oct.	565	Oct.	214	Oct.	451		
Nov.	773	Nov.	494	Nov.	131		
Dec.	366	Dec.	256	Dec.	27		

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING JUNE 30, 1917

The following report on the inspection of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

Ships and Vessels Inspected:

From foreign ports	428
From U. S. ports other than Florida	252
From Florida ports	427
Total	1107

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Shipments Inspected:

Arriving by water:

Passed	28	
Treated and passed	4	
Returned to shipper	52	
Detained, subject to return	0	
Contraband destroyed	266	
		350

Arriving by express, freight, etc.:

Passed	275	
Treated and passed	16	
Returned to shipper	7	
Detained, subject to return	25	
Contraband destroyed	21	
		344

Total shipments inspected 694

Principal Pests and Diseases Intercepted

Insect or disease	Occurring on	From	Number of shipments infested
Aspidiotus hederae	Chinaberry	Florida	1
Aspidiotus lataniae	Chinaberry	Florida	1
Bephrata cubensis	Soursop	Cuba	1
Crown gall	Currant	New Jersey	1
Crown gall	Rose	Florida	1
Crown gall	Rose	Pennsylvania	1
Crown gall	Rose	New York	2
Dictyospermum scale	Citrus	Spain	1
Florida red scale	Herbaceous plants	Florida	1
Florida red scale	Palms	Cuba	1
Florida red scale	Palms	Florida	1
Long scale	Citrus	Cuba	1
Mealy-bug	Palm	Florida	1
Melanose	Citrus	Florida	1
Purple scale	Citrus	Cuba	1
Purple scale	Citrus	Florida	1
Nematode root-knot	Chinese medicine plant	Florida	1
Nematode root-knot	Fig	North Carolina	1
Nematode root-knot	Fig	Florida	3
Nematode root-knot	Hibiscus	Alabama	1
Nematode root-knot	Japonica	Georgia	1
Nematode root-knot	Plumbago	Florida	1
Nematode root-knot	Rose	Florida	1
Rufous scale	Croton	Cuba	1
Rufous scale	Pandanus	Cuba	1
San Jose scale	Peach	Georgia	1
San Jose scale	Plum	Illinois	1
San Jose scale	Prune	Illinois	1
Soft brown scale	Jasmine	Florida	1
Soft brown scale	Lily	Florida	1
Soft brown scale	Maguey	Florida	1
Sweet potato root weevil	Sweet potato	Cuba	3
Whitefly	Chinaberry	Florida	1
Whitefly	Jasmine	Florida	2

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PARCEL POST PLANT INSPECTION

QUARTER ENDING JUNE 30, 1917

Parcels Inspected:

Passed	1796
Treated and passed	76
Returned to sender	1
Detained, subject to return	7
Infested or infected parcels destroyed	16
Total Parcels Inspected	1896

PESTS INTERCEPTED

Name	Found on	From	No. of Shipments
Citrus mealy bug	Coleus	Ohio	4
Crown gall	Apple	Nebraska	1
San Jose scale	Chinaberry	Florida	1
San Jose scale	Peach	Illinois	1
San Jose scale	Peach	Kentucky	1
Nematode root-knot	Canna	New York	1
Nematode root-knot	Chrysanthemum	Ohio	7
Nematode root-knot	Chrysanthemum	Florida	1
Nematode root-knot	*Dioscorea*	Illinois	1
Nematode root-knot	Fig	Florida	1
Nematode root-knot	Geranium	Ohio	1
Nematode root-knot	Geranium	Florida	1
Nematode root-knot	Grape	Pennsylvania	1
Nematode root-knot	Grape	Tennessee	1
Nematode root-knot	Hibiscus	Ohio	2
Nematode root-knot	Lemon verbena	Ohio	1
Nematode root-knot	Lilac	Ohio	1
Nematode root-knot	Rose	New York	1
Nematode root-knot	Rose	Ohio	71
Nematode root-knot	Rose	Indiana	1
Nematode root-knot	Rose	Illinois	1
Nematode root-knot	Rose	Louisiana	1
Nematode root-knot	Rose	Georgia	1
Nematode root-knot	Snowball	Ohio	1
Nematode root-knot	Tomato	Florida	2
Nematode root-knot	Tomato	Georgia	1

THE GROWER'S NEED OF A HAND LENS

F. M. O'BYRNE

The grower should familiarize himself with the various insect pests which he finds on his crops so that he will know what to expect when an insect is appearing in considerable numbers. Some insects make their presence known so suddenly that by the time specimens can be sent to an authority for identification and an answer received, the damage accomplished may be considerable, and control measures rendered worthless because of lost time.

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A magnifying glass or hand lens enables the grower to secure much useful information by direct observation.*

Recently the writer was talking to a successful orange grower and was surprised to learn that this grower had no magnifying glass. Upon being asked how he was able to control scale in his grove, the grower replied that he was a practical man and followed practical methods; that when the scale in his grove got bad he sprayed, that he repeated this spraying three weeks afterwards, and if the infestation was severe he gave a third spraying. Each spraying cost him fifty dollars. Had this grower possessed a hand lens and with it observed the development of the young scale-insects, he could have made one spraying, or at least two, accomplish the work of his three rule-of-thumb sprayings.

Scale-insects frequently make their appearance in broods. Certain conditions, such as drouths or spraying with fungicides like Bordeaux mixture, usually result in a rapid increase of scale-insects provided the grove is at all infested. By the use of a hand lens from time to time, the grower is able to tell when a new brood is coming on by observing the tiny insects or crawlers upon the tree. If he sprays when the oldest of the young insects are about three or four weeks old, the one spraying is likely to accomplish as much as the three sprayings given by our friend mentioned above.

On the other hand, if the grower waits until his trees show heavy infestation of adult scales before spraying, it is impossible for one spraying to bring them under control, and a fractional spraying, involving at least three separate applications is necessary.

All spraying work should be intelligently planned and executed. The grower should know when to spray and why, and the intelligent use of a magnifying glass will go far towards giving him this much needed information.

*The more common insects can be identified by the grower himself if he is supplied with a good text book on entomology written in language he can readily understand. "Injurious Insects; How to Recognize and Control Them," by O'Kane (MacMillan, New York, 1914) or "Insect Pests of Farm, Garden and Orchard," by Sanderson (John Wiley and Sons, New York, incorporated, 1915), are both good.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner* ..... *Editor*

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R. A. JEHLE ..... *Asst. Plant Pathologist*
FRANK STIRLING ..... *General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

NURSERY STOCK AND SCALE INSECTS. If buying a cow—which would you buy; one raised free from ticks from the start or one which had been neglected and had been tick-infested all its life, but which was dipped and cleaned up at the last moment? You would buy the one which had been tick-free all its life of course, and the man who raised cattle thus carefully would make more money out of his cattle than the other. His cattle would be worth more to all. Would not the same reasoning apply to the growing and selection of nursery stock?

Too many nurserymen and grove-owners who grow their own stock, consider it good business practice to allow it to grow up in any sort of condition, cleaning it up at the last minute before selling or using the trees. This is undoubtedly poor business practice from an economic point of view. A scale-infested nursery is a constant source of trouble and expense, and adequate spraying in a nursery is difficult and expensive. It is not such a difficult matter to grow stock scale free from the start. Seed beds should be located as far as possible from scale-infested stock. When seedlings are "lined out" in rows all those infested should be discarded or thoroughly scrubbed, and they should be *absolutely free* from scale before planting.

Some will say this is useless, as the top will be cut off and removed as soon as the buds are large enough. But while the young bud is putting out from an infested seedling, young scale insects are hatching and crawling onto it. Some scales are left below the union, and their young crawl onto the young bud. As

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a result of such practice the young tree is scale-infested from the very start. If the stock is free from scale, so will the budded stock be free nine hundred and ninety-nine times in a thousand.

In the spring of 1916 a nursery of 3,600 citrus seedlings was planted by the Nursery Inspection Department of the State Plant Board. Beginning July 1st, 1916, this nursery was sprayed periodically with a fungicide. A number of blocks have been sprayed weekly with Bordeaux mixture since that date, and have not been treated even once with an insecticide. Every grower knows in what a severely infested condition this stock would have been had it had even the slightest scale infestation when planted. They were scrubbed free from scale before they were planted, however, and, as a result, they are still free from scale, although standing within fifty paces of infested trees. This is but one of many instances which could be cited, all of which demonstrate conclusively that it pays the producer to *grow* his stock clean from the start, and thus secure far stronger, better trees. They are the kind of trees you would want to get if you were buying.—F. M. O'B.

RED ASCHERSONIA. This fungus, commonly called the Red Whitefly Fungus, was first discovered in Florida in 1893, by Dr. H. J. Webber of the U. S. Dept. Agr., in the citrus grove of Mr. J. H. Harp at Crescent City. Dr. Webber not only discovered its usefulness as a whitefly destroyer, but described and gave it its scientific name. Dr. Webber also found that he could introduce this fungus into other whitefly-infested trees and groves by pinning fungus-bearing leaves beneath leaves infested with whitefly and by planting small trees with fungus so that their leaves would touch the other leaves.

When the writer came to the State in 1906, as Entomologist of the Florida Experiment Station, Professor P. H. Rolfs, Director, showed him a whitefly-infested tree and advised that the control of this pest would be his immediate and principal problem. The fungus problem, of course, went with the larger problem. It was the writer's good fortune to be able to show, after a few months' experimenting, that the Red Aschersonia could be readily started on the whitefly by simply spraying with a mixture of the fungus spores and water.

Following the good results with the spraying plan of introducing fungus, this method soon became popular and hundreds of thousands, if not millions, of trees were sprayed by grove

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owners, and by others who engaged in commercial spraying of the fungus.

While this was in progress, Prof. H. S. Fawcett, Plant Pathologist of the Florida Experiment Station, was conducting his scientific studies of the fungi parasitic on the whitefly, and developed his method of growing pure cultures of the Red Aschersonia on sterilized sweet potato. The writer soon undertook the growing of similar cultures; at one time producing as many as 50 pint-bottle cultures. This was in 1909 or 1910, but as there was no apparent need of an artificial supply of fungus at that time the production of pure cultures was discontinued.

Following the advent of citrus canker the possible danger of spreading canker by collecting fungus directly from trees became evident. The Plant Board then instructed its Department of Entomology to grow the Red Aschersonia in pure cultures in large quantities. Last year (1916) 358 salable cultures were produced and 328 sold to growers while this year between 1,500 and 1,800 salable cultures have been made ready.

Nearly all the work of producing this year's cultures has been done by Mr. C. E. Wilson, Assistant Entomologist. These cultures are now for sale at 50c each, the purchaser paying transportation charges. A culture is sufficient for an acre of grove, and when packed for shipment, weighs about 1 pound. Directions for using the cultures are sent with each order. The period of summer rains, now on, is the time to introduce the fungus. Growers having whitefly in their citrus groves are urged to use the fungus at once even if the whitefly is not abundant, in order to get it established before the late summer brood of flies emerges.

All orders should be sent to the Department of Entomology, State Plant Board, Gainesville, Fla. Checks and money orders should be made payable to the State Plant Board.—E. W. B.

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THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

VOLUME II

1917-'18

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Published by
STATE PLANT BOARD OF FLORIDA
Gainesville, Fla.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. II | OCTOBER, 1917 | No. 1

THE ROLL OF HONOR

The following employes of the State Plant Board of Florida are serving in the several branches of the military service:

Ball, Jos. H.	Aviation Section
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Bradford, Horace	Federalized National Guard
Branam, Jas. R.	Navy
Butts, J. L.	Ambulance Corps
Calcote, W. H.	Officers Reserve Corps
Cary, Chas. L.	National Army
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Grimes, D. W.	Aviation Section
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Hood, Richard Van	Lieut., Marine Corps
Howell, John F.	Officers Reserve Corps
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Little, Floyd L.	Aviation Section
Maloney, Clarence B.	"Somewhere in Europe"
Neal, Cecil G.	Officers Reserve Corps
Niedernhoefer, Wm. F.	Aviation Section
Roberts, Samuel F.	Navy
Smith, J. G.	National Army
Stephens, Chas. M.	National Army
Swann, Porter R.	Sergt., Cavalry
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Wilson, Guy H.	2nd Lieut., Field Artillery

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SOME FLORIDA SCALE-INSECTS

C. E. Wilson

In May of 1916 the author became an inspector of the State Plant Board of Florida and, failing to find any literature on Florida scale-insects other than scattered papers, the need of such a publication was, time after time, forcibly brought to his attention. The opportunity for bringing together this literature was, however, not presented until February of 1917, when he was transferred from field inspection work to the Entomological Department of the State Plant Board at Gainesville.

Noting the number and species of the scales daily sent to the Entomological Department for identification by inspectors in the field it was decided, after a brief conference with Mr. Wilmon Newell, Plant Commissioner, and Dr. E. W. Berger, Entomologist, to undertake the work of listing, illustrating and briefly describing the Florida species.

The original intention of the author was to make this a technical report, but on the advice of the Plant Commissioner and Entomologist, it was decided to prepare, as nearly as possible, a practical bulletin for the use of the field inspectors and grove owners.

In arrangement of species it was decided to use the common name instead of generic name, as it would probably prove more convenient for practical usage.

The amount of time given to the preparation of this report has not permitted the listing or collecting of all the Florida species, but it is hoped that this paper will prove to be an introduction for the continuation of the work on Florida scales.

The food plants herein listed are divided into two groups, namely: those found to be infested in Florida, and those which are known to be infested, but so far not taken in Florida.

The distribution as given for Florida includes only the localities from which specimens have been received or taken by the author.

Methods of control for scale-insects are treated of by Dr. Berger in a separate article in this issue.

I desire to make acknowledgment to Messrs. Wilmon Newell and Dr. E. W. Berger for various criticisms and suggestions.

To the assistant nursery inspectors, and more especially to Messrs. F. F. Bibby, F. W. Poos, Jr., and U. C. Zeluff, am I indebted for the zeal and enthusiasm with which they collected material for identification. To Professor J. R. Watson, Ento-

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mologist of the Florida Agricultural Experiment Station, I am indebted for specimens, literature and the distribution of several of the species herein listed and to Mr. Julius Matz, of the Florida Experiment Station, for assistance in photographing specimens. To Mr. E. R. Sasscer of the Federal Horticultural Board, I am indebted for his courtesy in determining and verifying a number of species of which I was in doubt, and to Dr. L. O. Howard, Chief of the Bureau of Entomology, and Mr. A. A. Girault for determination of several parasites. Miss Ella M. Evans, stenographer in the Entomological Department, has faithfully assisted the author in preparation of the manuscript.

Grouping and Characters of Florida Scales

Scale-insects may be conveniently divided into two groups, the "armored" scales and the "unarmored" or soft scales. The armored scales are those forming a protective covering over the body. This covering is caused partly by excretion from the insect, and partly by the molted or cast skins. This group of scale-insects soon settle down to feed, after being hatched, and losing their legs also lose the power of locomotion, so cannot change their position.

The unarmored, or soft scales, are those which secrete no protective covering, and retain their legs and power of locomotion throughout life; however, they do not move much after they have started feeding, except in the case of the cottony cushion-scale and mealy bugs. In the case of the wax scales and the Lecaniums a migration of the older scales from the leaf to the twig frequently occurs.

In both groups the males, in the early stages, are similar to the females, but later in life they pupate and finally emerge as minute, two-winged insects which resemble gnats. The winged males are short-lived individuals and their only function is the fertilization of the females. They possess no mouth parts and do not feed during their life.

The majority of our important scale-insects belong to the armored scales. The habits of the species of this group are similar. The eggs are produced in large numbers, a single female producing from 100 to 500. These are deposited under the scale covering of the mother and undergo a period of incubation before hatching. In some cases we find the young partly or fully developed within the body of the female from which they emerge as active insects. The young of all armored scales are similar,

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and are not distinguishable without the aid of a microscope. They are very minute yet are visible to the unaided eye and during the breeding season may, by close inspection, be found on leaves, stems or fruits. For the most part the color of the young scales is light yellow or light orange. In all cases the young of armored scales have six well developed legs, and also possess eyes and antennae. Shortly after emerging from the egg (from a few minutes to an hour or two) the young find a suitable resting place and settle down, thrusting their long thread-like beaks into the plant, and commence to grow. The first evidence of growth is the secretion of waxy filaments on the upper surface of the body. This is the beginning of the scale-covering. The waxy secretion continues during the life of the insect and the scale-covering is enlarged as the insect increases in size. The females of the armored scales undergo two molts and the cast skins form a definite part of the scale-covering. After the second molt the female soon reaches full size and, after being fertilized by the male, begins to develop her brood.

The early stages of the male correspond exactly to the early stages of the female, but on the second molt the male development diverges entirely from that of the female. The old skin is thrust out from beneath the scale-covering and does not become a part of it. In the second molt the antennae, legs and wings are partly developed. The third molt results in the final pupal stage. The fourth and last molt produces the perfect male which escapes from beneath the scale-covering and is able to fly about. The length of time for the molting varies for different species; however, the full growth is reached in from four to six weeks in summer and in winter the development is slower.

The female scale-insect never moves from her position after she thrusts her beak into the tissue of the plant and if removed by force soon dies. From the habits of the armored scales it is readily seen that the spread of the insects is limited entirely to the larval stage.

In the second group, or the unarmored scales, we find the ones that possess no waxy secretion or armor as a covering. The development for the species of the unarmored group is similar. All species retain their power of locomotion throughout life and are not marked by the retrograde development of the armored scales. In all cases they excrete honeydew in which develops a black "sooty mold" or fungus, covering the foliage of the in-

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fested plants. The life histories of the unarmored species are similar to that of the armored species.

Explanation of Terms

The terms "scale of female" and "scale of male" are applied in this paper only to the thin covering on the dorsal surface of the body of the scale-insect. It is composed partly of an excretion from the insect and partly of molted or cast skins.

The term "ventral scale" when used applies only to the covering found between the body of the scale-insect and the bark of the plant to which it is attached.

The term "exuviae" is applied only to the molted larval skins which form a part of the scale. The position of the exuviae is indicated in each case as "central," meaning center of scale, "sub-central," meaning near the center but to one side, or between the center and the outer margin of the scale, and "marginal," meaning near the outer margin of the scale.

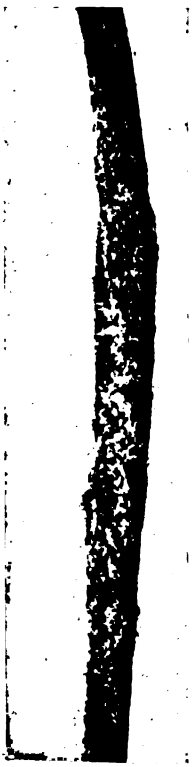

Fig. 1.—The Aspidistra Scale, *Hemichionaspis aspidistrae* (Sign.), on *Jacquemontia pentantha*. Enlarged twice. (Original.)

Aspidistra Scale

Hemichionaspis aspidistrae (Sign.)

Scale of Female.—The scale of the female is from 1.5 mm. to 2.2 mm. (1/16 to 1/11 inch) in length. It is usually broadly rounded at the posterior end. It is semitransparent, flat and of a pale brown color. The exuviae are about the same color as the scale and are rather conspicuous.

Scale of Male.—The scale of the male is elongated and slender. It is white in color, tricarinate and the exuviae are light yellow.

Plants found infested in Florida: Asparagus fern; *Aspidistra lurida; Asplenium serratum;* Boston fern; budwert fern, cocoanut palm.

Other plants liable to become infested*: *Acacia melanoxylon; Areca catechu; Cocos plumosa; Cyanotus; Davallia moorei;* fig; mango; orange; orchids; pepper tree.

Distribution in Florida: Clearwater; Ft. Myers; Little River; Oneco; Orlando; Palatka; Tampa; West Palm Beach.

* i. e. Other known host plants.

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Aspidiotus cydoniae Comst.

Scale of Female.—The scale of the female is about 3/50 inch (1.5 mm.) in diameter. It is convex, grayish or brownish in color and somewhat transparant. The exuviae are subcentral and are dark brown or black in color.

Scale of Male. The scale of the male is similar to that of the female, but smaller.

Plants found infested in Florida: quince.

Other plants likely to become infested: cactus, fig, *Jasminum, Lantana,* orange, palms, tea-plant.

Remarks: This scale has not been received in this office up to the present time, but was described from Florida specimens by Prof. J. H. Comstock.

Aspidiotus pseudospinosus Woglum

Scale of Female.—The scale of the female is from 1.5 mm. to 2 mm. in diameter and is circular or somewhat oval in shape. It is slightly convex and is usually covered by a brown fungus.

Fig. 2.—Bamboo Scale, *Asterolecanium bambusae* Bdv., on bamboo. Enlarged twice. (Original.)

Plants found infested in Florida: *Andromeda* sp.; live oak.

Other plants liable to become infested: oaks.

Distribution in Florida: Ft. Pierce; Lake Butler; Lake City; West Palm Beach.

Remarks: The author is indebted to Prof. J. R. Watson of the Florida Experiment Station for the record of this scale, on *Andromeda* sp. This scale was originally described from specimens collected from Florida on saw palmetto by W. H. Field in 1882.

BAMBOO SCALE

Asterolecanium bambusae Bdv.

Scale of Female. The scale of the female is from 2 mm. to 2.5 mm. in length. It is oval, convex above, glassy, semitransparent and colorless or tinged with green or yellow. It is elongated and narrowed slightly behind.

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Scale of Male.—The scale of the male is not known.

Plants found infested in Florida: bamboo; *Bambusae vulgaris*; persimmon.

Distribution in Florida: Avon Park; Bradentown, Clearwater; DeLand; Ft. Myers; Gainesville; Kissimmee; Lakeland; Little River; Lutz; Miami; Orlando; Tampa; Terra Ceia; Waverly; West Palm Beach.

Fig. 3.—Barnacle Scale, *Ceroplastes cirripediformis* Comst., on persimmon. Slightly enlarged. (Original.)

Barnacle Scale

Ceroplastes cirripediformis Comst.

Scale of Female.—The scale of the female is 4 mm. in diameter, 4 mm. high and 5 mm. long. The waxy covering is dirty white, mottled with several shades of gray or light brown plates. There is one large convex dorsal plate and six lateral ones, each with a central nucleus.

Plants found infested in Florida: citrus, guava, wild persimmon.

Other plants likely to become infested: *Eupatorium, Lignum-vitae,* myrtle, quince, and *Solanum.*

Distribution: This scale is generally distributed throughout the State, but is of slight economic importance.

Black Lecanium

Lecanium nigrofasciatum Pergande

(Fig. 4)

"The shape is oval, broader posteriorly, and hemispherical. The cuticle varies in color from light or dark red to black, with the median stripe lighter and with small clear areas each of which contains a very small dot. There are also a few small sets scattered on the dorsal surface. Length, 3-4 mm.; width 2.6 mm. The antenna has six segments, the third, which is the longest, having three setae. The anal plate is nine-sixteenths as broad as long with the cephalo-lateral and caudo-lateral margins sub-equal, and with the lateral extremity and apex sharp, and a faint scar close to cephalo-lateral margin near the lateral extremity. There are two subapical and three apical setae with

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two of the latter on the outer lateral margin and one a slight distance from the apex. There are four fringe setae in groups of two with the inner two one-half as long as the outer. The middle spiracular seta is broader at the apex than at the base and the other two are slightly tapering. The marginal setae are short, hair-like and acuminate. On the dorsum, there is an

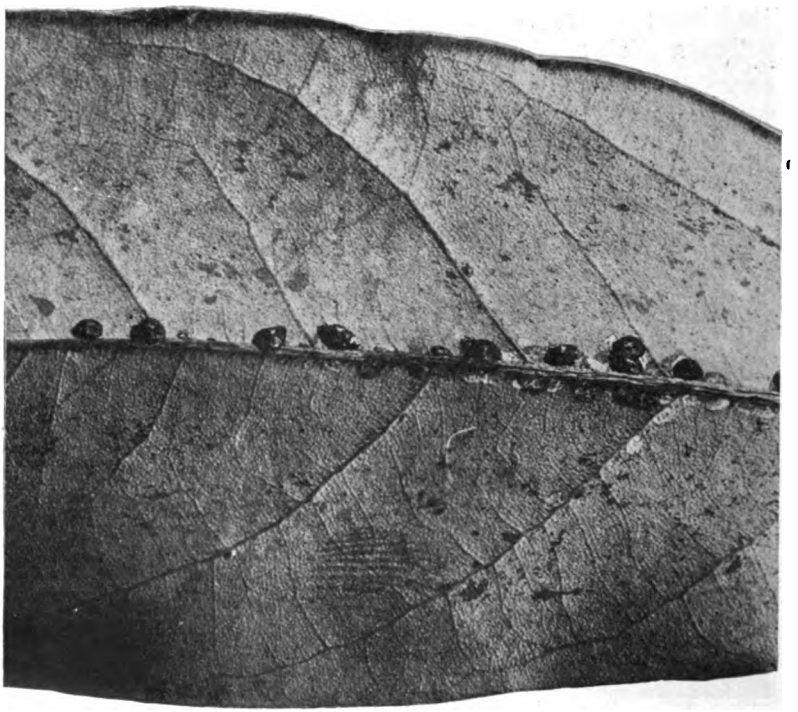

Fig. 4.—Black Lecanium, *Lecanium nigrofasciatum* Perg., on oak. Slightly enlarged. (Original.)

irregular row of about thirty low, conical appendages extending along the meson in front of the plates."

Plants found infested in Florida: bay; blueberry; oak.

Other plants liable to become infested: apple; birch; linden; maple; olive; peach; plum; *Vaccinium.*

Distribution in Florida: Ponce Park; Sebring.

Remarks: The above description is copied from that of Wm. C. Thro (Cornell University Experiment Station Bulletin 209, page 211, 1903).

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Black Scale

Saissetia oleae (Bern)

Adult Female.—The length of the adult female is from 2 mm. to 5 mm. (⅛ inch to ¼ inch). It is black or dark brown in color, rather hard, almost hemispherical and has a distinct "H" on the dorsal surface.

Adult Male.—The adult male is light yellow in color and very minute.

Plants found infested in Florida: avocado; fern; *Ficus aurea; Ficus elastica; Ficus indica; Glycosmis pentaphylla;* guava; *Lagerstroemia;* mango; mountain ebony; pigeon pea; *Rheedia aristata; Rheedia edulis; Sapodilla;* Spanish needle; *Terminalia;* tropical almond.

Other plants liable to become infested: almond; *Antidesma;* apple; apricot; aster; *Camellia; Chrysanthemum; Eucalyptus; Ficus pandurata;* fig; grape; *Grevillia;* holly; Irish juniper; laurel; locust; magnolia; maple; mountain ash; nightshade; oleander; olive; orchids; Oregon ash; palms; pear; pepper tree; phlox; plum; pomegranate; poplar; privet; prune; rose; Sago palm; sumac; sycamore, *Vitis;* watermelon.

Distribution in Florida: Bradentown; Clearwater; Cocoa; Delray; Ft. Myers; Ft. Pierce; Miami; Oneco; Palm Beach; Redland; West Palm Beach; Winter Haven.

Fig. 5.—Black Scale, *Saissetia oleae* (Bern), on *Ficus aurea*. Slightly enlarged. (Original.)

Remarks: Specimens of *Saissetia oleae* collected at West Palm Beach, Florida, were infested with a scale-eating moth, *Laetilia coccidivora.*

Black Thread Scale

Ischnaspis longirostris (Sign.)

(Fig. 6)

Scale of Female.—The scale of the female is from 2 mm. to 3 mm. (1/12 inch to 1/8 inch) in length. It is long, narrow and somewhat convex. The sides are almost parallel, the pos-

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terior margin being slightly broader. The color is shining black with slightly grayish margins.

Plants found infested in Florida: *Dictyosperma rubrum;* Gog palm; *Ixora parviflora; Lantania;* mango; Phoenix palm.

Other plants liable to become infested: *Ficus* sp., jasmine; *Magnolia grandiflora; Monstera;* palmetto; palms; *Pandanus.*

Distribution: Miami; Oneco; West Palm Beach.

Boisduval's Scale

Diaspis boisduvalii Sign.

(Fig. 7)

Scale of Female.—The scale of the female is from 1.2 mm. to 2.2 mm. (4/100 inch to 8/100 inch) in diameter. It is cir-

Fig. 6.—Black Thread Scale, *Ischnaspis longirostris* (Sign.), on *Ixora parviflora.* Enlarged slightly. (Original.)

cular in shape and somewhat ovate. It is thin and semitransparent. The color varies from snow-white to light yellow and the scale has a waxy appearance. The exuviae are light yellow or white and are central or subcentral in position.

Scale of Male.—The scale of the male is strongly tricarinate, white, more or less massed and is covered with a quantity of curly white hairs.

Plants found infested in Florida: *Latania; Livistona rotundifolia;* orchid; palm; *Phoenix rupicola; Seaforthia; Washingtonia robusta.*

Other plants liable to become infested: *Acacia; Cattleya;* palms; wattle.

Distribution in Florida: Estero; Ft. Myers; Ft. Pierce; Miami; Palm Beach; St. Petersburg; Tampa; West Palm Beach.

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CACTUS SCALE

Diaspis echinocacti cacti Comst.

(Fig. 8)

Scale of Female.—The scale of the female is thin and approxi-

Fig. 7.—Boisduval's Scale, *Diaspis boisduvalii* Sign., on *Livistona rotundifolia*. Enlarged twice. (Original.)

mately circular. It is of a grayish or greenish-white color. The exuviae are central or subcentral and dark brown in color.

Scale of Male.—The scale of the male is white or light green, and it is oblong and crinate.

Plants found infested in Florida: cactus *(Opuntia* sp.*)*.

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Other plants liable to become infested: *Cereus giganteus; Cereus macrogonus;* Echino cactus.

Distribution in Florida: Jacksonville.

Remarks: The only specimens of the cactus scale received were collected by Mr. E. K. Bynum at Jacksonville, Florida.

California Red Scale

Chrysomphalus aurantii (Mask.)

(Fig. 9)

Scale of Female.—The scale of the female is 2 mm. in diameter. It is flat and thin and of a light gray color, but the

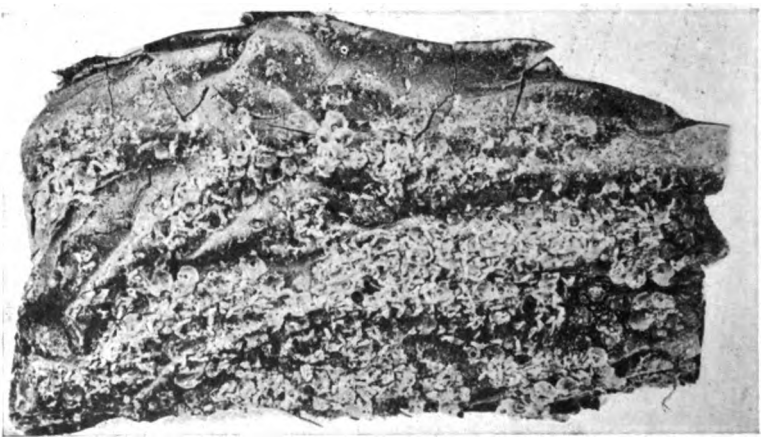

Fig. 8.—Cactus Scale, *Diaspis echinocacti cacti* Comst., on *Opuntia* sp. Enlarged twice. (Original.)

body showing through gives the scale a decidedly reddish or reddish-brown tinge. The exuviae are central.

Scale of Male.—The scale of the male is similar to that of the female, but is much smaller and is gray or dark brown in color.

Plants found infested in Florida: citrus; palm.

Other plants liable to become infested: apple; cocoanut; euonymus; fig; grape; lignum-vitae; olive; pear; plum; quince; rose, willow.

Distribution in Florida: Clearwater; Cocoa; Goulds; Largo; Miami; Oakhurst; Ozona; Princeton; Redland; Saint Petersburg; Silver Palm; Sutherland.

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CHAFF SCALE
Parlatoria pergandii Comst.

(Fig. 10)

Scale of Female.—The scale of the female is about 1.6 mm. (3/50 inch) in length. It varies from a circular to oblong shape,

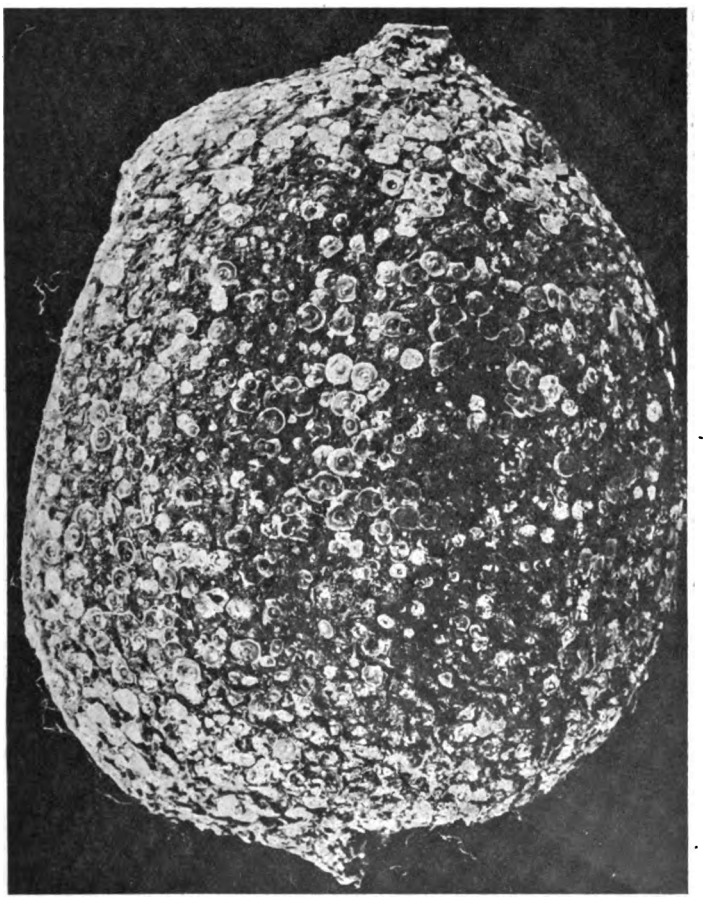

Fig. 9.—California Red Scale, *Chrysomphalus aurantii* (Mask.), on lemon. Enlarged twice. Photograph of specimens received from E. O. Essig, San Diego, Cal. (Original.)

and is of a dirty gray or brownish-gray color. The exuviae are central or subcentral.

Scale of Male.—The scale of the male is purplish or grayish purple in color. It is smaller than the female, but similar in outline.

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Fig. 10.—Chaff Scale, *Parlatoria pergandii* Comst., on orange. Enlarged twice. (Original.)

Plants found infested in Florida: *Areca;* camphor; *Carissa* sp.; cinnamon; citrus; cocoanut; *Cocos datil; Eugenia; Ficus elastica; Hydriastele wendlandiana;* Italian lemon; japonica; *Jasminum officinale;* mango; oleander; palm; *Phoenix farinifera; Phoenix pumila;* Sago palm; *Seaforthia; Trachycarpus excelsa;* wandering Jew; *Washingtonia robusta.*

Distribution in Florida: Generally distributed over the State.

Cherry Scale

Aspidiotus forbesi Johnson

Scale of Female.—The scales of the female are almost circular when not crowded or grouped together. The diameter is about 2 mm. The scale for the most part is convex and ranges from dirty gray to dark gray in color. The exuviae are covered. They are of orange color and are usually subcentral in position.

Scale of Male.—The scale of the male is similar to that of the female, but longer and darker.

Plants found infested in Florida: plum.

Other plants liable to become infested: *Acer pseudoplatanus;* apple; apricot; beech; cherry; *Crataegus;* currant; gooseberry;

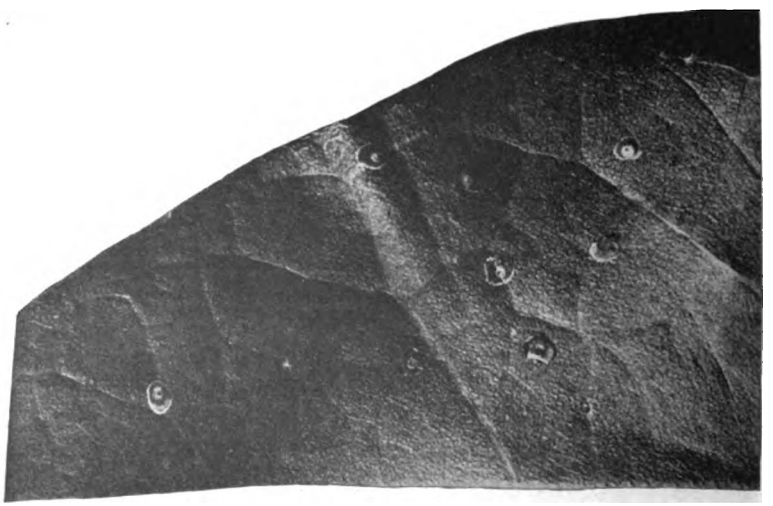

Fig. 11.—*Chrysomphalus agavis* on avocado. Enlarged twice. (Original.)

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hawthorne; honey locust; jasmine; peach; pear; quince; walnut.

Distribution in Florida: Macclenny.

Remarks: The specimens of cherry scale received were collected by Mr. F. F. Bibby at Macclenny, Florida.

Chrysomphalus agavis
(Towns. & Ckll.)

(Fig. 11)

Scale of Female.—The scale of the female is from 1.5 mm. to 2 mm. in diameter. It is reddish-brown or dark brown in color with the outer margin of the scale light brown. The scale is somewhat flattened and is circular or oblong in shape. The exuviae are central in position and are dark-brown or black in color.

Scale of Male. — The scale of the male is similar to the scale of the female, but smaller and lighter in color.

Plants found infested in Florida: avocado; cabbage palmetto.

Other plants liable to become infested: agave.

Distribution in Florida: Ft. Pierce; St. Cloud.

COCOANUT MEALY BUG
Pseudococcus nipae
(Mask.)

Adult Female. — The adult female is small and

Fig. 12.—Cocoanut Mealy Bug, *Pseudococcus nipae* (Mask.), on guava. Enlarged twice. (Original.)

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is covered with compact, thick, yellowish-white wax plates, which project from sides as thick short spines. It is from 1.5 mm. to 3 mm. (3/50 inch to 3/25 inch) in length.

Adult Male.—The adult male is small and yellow.

Plants found infested in Florida: *Anona muricata;* avocado; cabbage palmetto; *Coccolobis;* cocoanut; custard apple; guava; Mammea apple; mulberry; palm; Phoenix palm.

Other plants liable to become infested: *Nipa fruticans;* palms.

Distribution in Florida: Bradentown; Ft. Myers; Ft. Pierce; Gainesville; Homestead; Miami; Oneco; Orlando; Palm Beach; St. Petersburg; West Palm Beach.

Fig. 13.—Common Mealy Bug, *Pseudococcus citri*, on grapefruit. Slightly enlarged. (Original.)

Common Mealy Bug
Pseudococcus citri (Risso)

Adult Female.—The length of the female is from 2.5 mm. to 4 mm. (1/10 inch to 1/4 inch). It is white or yellowish-brown in color. The legs and antennae are brownish. The powdery secretion is slight on the surface of the body. The filaments on the lateral and posterior edges of the body are short, but distinct.

Adult Male.—The adult male is a small, pale, two-winged insect, having two long, white anal filaments.

Plants found infested in Florida: citrus; Lantana; Lantania; mastic; palmetto; potato; ragweed; royal palm (roots).

Other plants liable to become infested: *Acalypha; Bignonia;* bottle-brush; *Bouvardia; Callistemon lanceolatus;* citron; *Cestrum;* coffee; coleus; cotton deer-brush; English ivy; ferns; fuchsia; geranium; Guadaloupe palm; grape; *Ipomoea;* ivy; leadwort; moonflower; nettle; nightshade; oleander; passion vine; peony; poinsettia; potato; pumpkin; redwood; *Rex bignonia; Solanum jasminoides;* tobacco; umbrella plant; wandering Jew.

Distribution: Distribution is general over the State.

Conchaspis angraeci Ckll.
(Fig. 14)

Scale of Female.—The scale of the female is approximately circular and somewhat conical. The apex is bluntly pointed and the margins are broad and flat. Six or eight ridges radiate from

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the apex, but part disappear before reaching the margin. The color is white or grayish-white. The scale is from 2 mm. to 2.5 mm. in diameter.

Plants found infested in Florida: *Acalypha;* fig; hibiscus; holly; *Pittosporum; Tabernae montana;* wisteria.

Other plants liable to become infested: *Angraecum; Rodriguezia secunda.*

Distribution in Florida: Clearwater; Miami; Palm Beach; Tampa.

Fig. 14.—*Conchaspis angraeci* Ckll., on *Acalypha.* Enlarged twice. (Original.)

The Cottony Cochineal Insect
Dactylopius confusus (Ckll.)

Adult Female.—The adult female is easily recognized by large flocculent masses of thick, white, cottony or waxy material, which is secreted as a covering for the body of the female. The body of the female is red and when crushed yields a bright crimson colored fluid. The length of the scale is from 3 mm. to 6 mm.

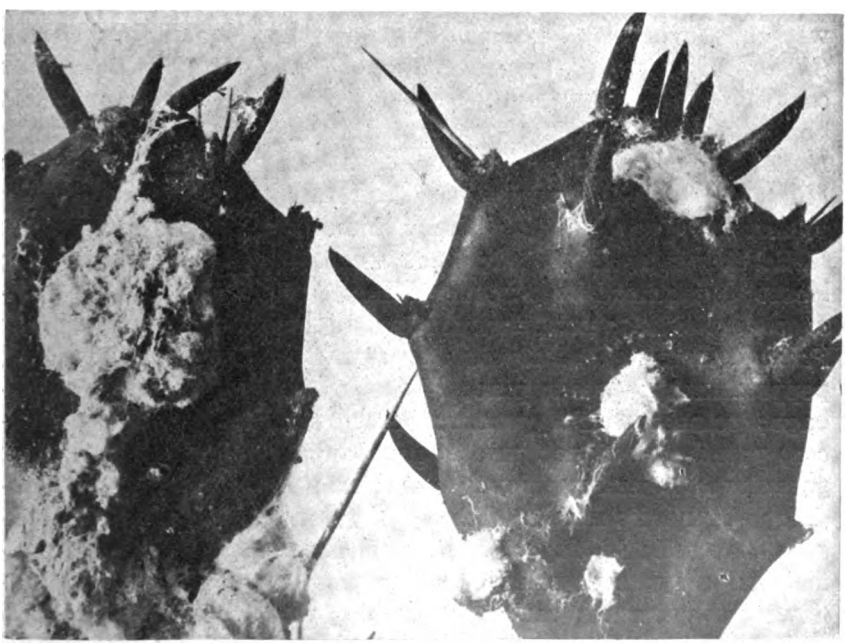

Fig. 15.—The Cottony Cochineal Insect, *Dactylopius confusus* (Ckll.), on *Opuntia.* Enlarged twice. (Original.)

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Adult Male.—The adult male is similar to the female. The cocoons are snow white and are usually massed with females.

Plants found infested in Florida: cactus *(Opuntia)*.

Other plants liable to become infested: *Echinocactus*.

Distribution: Citra; Crooked Lake; Gainesville; Lynn; Maitland; Sebring.

Cottony Cushion—, or Fluted, Scale
Icerya purchasi Mask.

(Fig. 16)

Adult Female.—Mature females have large, white, fluted, cottony egg masses at the posterior end of the red, yellowish or dark brown bodies. The eggs are deposited in the cottony mass.

Adult Male.—The adult male is a small, two-winged, red-bodied insect, having long antennae.

Plants found infested in Florida: citrus; cowpeas; guava; myrtle; rose; wild bamboo; wormwood.

Other plants liable to become infested: *Acacia;* alfalfa; *Amaranthus; Ambrosia;* apple; apricot; *Artemisia ludoviciana;* Australian black wood; Australian pine; banyan; Bermuda grass; *Bidens pilosa;* bottle brush; *Bougainvillea;* box wood; bridal wreath; *Carex* sp.; castor bean; cedar of Lebanon; *Cenchrus; Chenopodium* sp.; *Chrysanthemum; Chrysolidocarpus lutescens;* cocoanut palm (nuts only); coleus; cork elm; cypress; dwarf box; dwarf flowering almond; English ivy; English walnut; *Epilobium coloratum; Erigeron canadensis;* fig; fish-tail palm *(Caryota urens)*; flowering almond; foxtail grass; geraniums; golden rod; grape; grass; gumbo limbo; hackberry; hawthorne; *Helianthus* sp.; ironweed; knot weed; lambs-quarter; laurel; locust; loggerhead breast; magnolia; *Malva rotundifolia; Medicago denticulata;* mulberry; nettle; nightshade; oak; oleander; *Panicum crus-galli; Paspalum* sp.; peach; pear; pecan; pepper; peppermint; pigweed; pine; *Pittosporum; Plantago* sp.; plumbago; poinsettia; *Polygonum;* pomegranate; *Portulaca oleracea;* potato; purslane; quince; ragweed; rose de Montana; rose geranium; rosemary; royal poinciana; *Rumex crispus; Sapodilla;* shepherd's needle; *Sidum* sp. (stone crop); smilax; *Solanum douglasii; Solidago; Sonchus oleraceus;* Spanish lime; Spanish mulberry; spearmint; *Stachys aequata;* strawberry; sunflower; sweet gum; verbena; veronia; walnut; white oak; wild greasewood; willow.

Distribution in Florida: Alturas; Ashton; Auburndale; Avon

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Park; Bartow; Blanton; Bowling Green; Bradentown; Brewster; Brownville; Buchanan; Clearwater; Cocoanut Grove; Crooked Lake; Crystal River; Dade City; Davenport; Dover; Dundee; Dunedin; Eagle Lake; Elfers; Eloise; Eustis; Fellsmere; Flor-

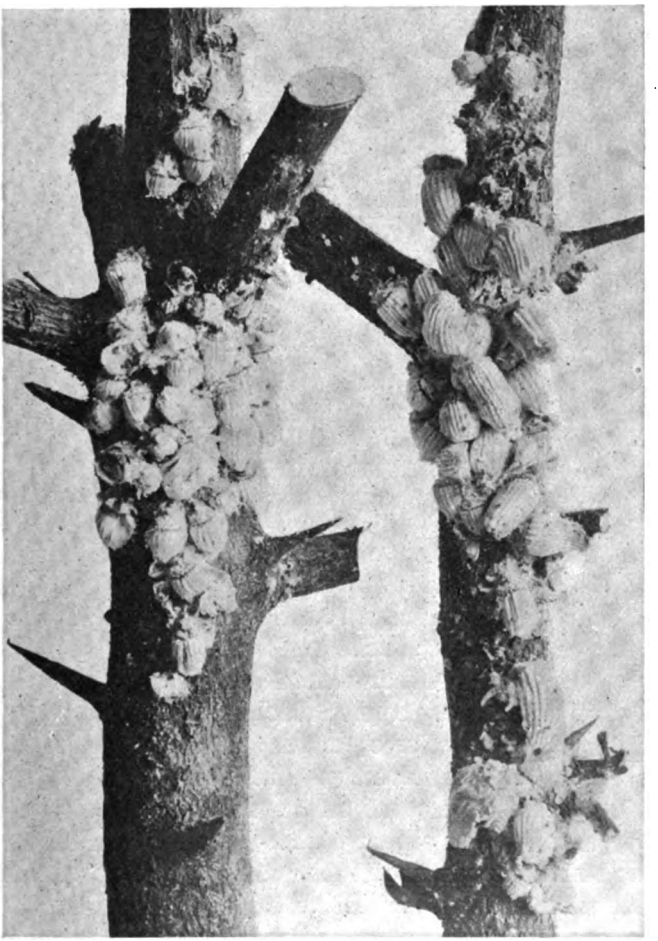

Fig. 16.—Cottony Cushion—, or Fluted, Scale, *Icerya purchasi* Mask., on grapefruit. Natural size. (Original.)

ence Villa; Ft. Green; Ft. Green Springs; Ft. Meade; Ft. Myers; Ft. Pierce; Frostproof; Glenwood; Gordonville; Haines City; Indian Rocks; Inverness; Kathleen; Key West; Kissimmee; Knights; Kuhlman; Lake Alfred; Lake Gem; Lake Hamilton; Lakeland; Lake Wales; Lake Weir; Largo; Leesburg; Limona; Lutz; Lynne; Magdalene; Manatee; Mango; Miami; Narcossee;

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Nocatee; Odessa; Oneco; Ozona; Palm City; Palmetto; Parrish; Pensacola; Plant City; Plymouth; Riley; Riverview; Safety Harbor; St. Cloud; St. Petersburg; San Antonio; Sebring; Seffner; Seminole; Shell Beach; Socrum; Stuart; Sutherland; Tampa; Tangerine; Tavares; Terra Ceia; Thonotosassa; Umatilla; Valrico; Wauchula; Waverly; White City; Wiersdale; Wimauma; Windermere; Winter Garden; Winter Haven; Winter Park; Yalaha; Zolfo.

Remarks: Most of the specimens of cottony cushion-scale received during the months of July and August were severely infested with two scale-eating moths, *Laetilia coccidivora* and *Pyroderces rileyi.*

Fig. 17.—Cottony Maple Scale, *Pulvinaria vitis* (Linn.), on wild grape. Natural size. (Original.)

Cottony Maple Scale
Pulvinaria vitis Linn.

Adult Female.—The length of the female is from 4 mm. to 6 mm. (about ¼ inch). The color varies from light to dark brown. It is oblong in shape, convex and the surface is transversely wrinkled. The egg-sac is secreted posteriorly and is composed of a cottony material.

Plants found infested in Florida: Boston ivy; pecan; wild grapevine.

Other plants liable to become infested: alder; apple; blackberry; box-elder; boxwood; buckeye; citrus; currant; elms; euonymus; gooseberry; hackberry; hawthorne; lilac; linden; locust; maples; mountain ash; mulberry; oak; osage orange; peach; pear; plum; poplar; quince; rose; sarsaparilla; *Spiraea;* sumac; sycamore; *Viburnum;* willow; woodbine.

Distribution in Florida: Brooksville; City Point; Gainesville; Hawthorne; Palatka.

The Cyanophyllum Scale
Aspidiotus cyanophylli Sign.

Scale of Female.—The scale of the female is circular to ovate in outline. It is from 1.5 mm. to 2 mm. in diameter, and of a brownish-yellow or pinkish color. The exuviae are central in position and bright yellow in color, often with a nipple-like mass of white excretion.

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Scale of Male.—The scale of the male is similar to that of the female, but the exuviae are subcentral and the outline elliptical.

Plants found infested in Florida: hammock bay.

Other plants liable to become infested: *Cinchona; Cyanophyllum; Cycas revoluta; Ficus indica; Ficus laurifolia; Ipomoea; Laurus;* moonflower; orchids; palms; *Pritchardia filifera;* tea.

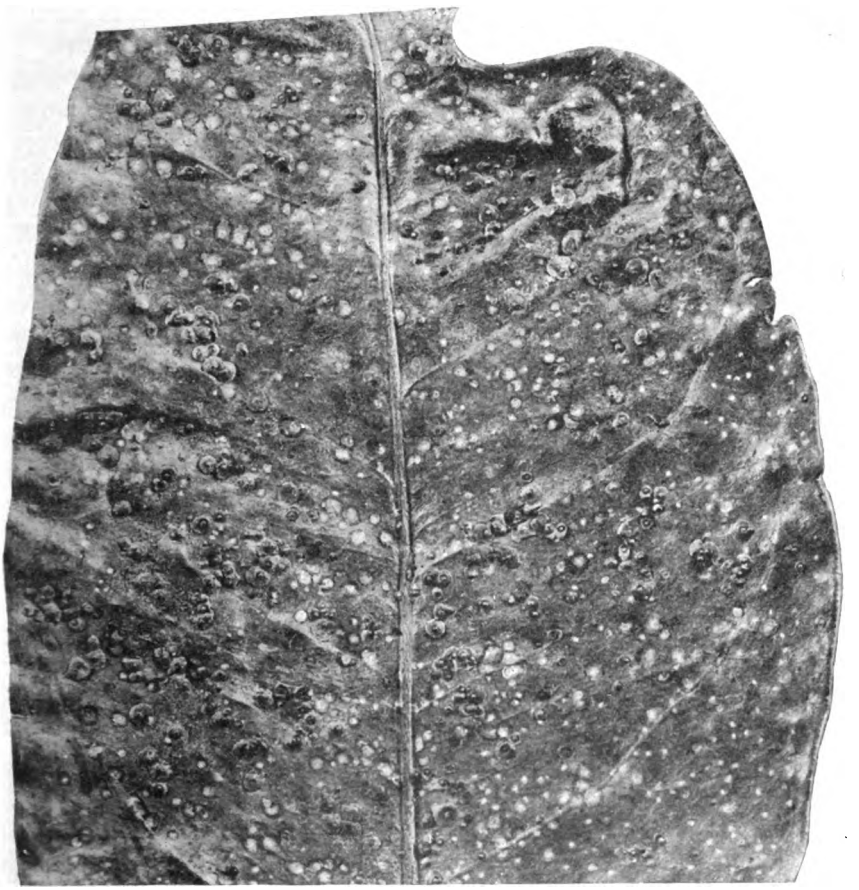

Fig. 18.—Dictyospermum Scale, *Chrysomphalus dictyospermi* (Morg.), on orange. Enlarged twice. Photographed from specimens collected in Spain by Prof. H. H. Hume. (Original.)

Distribution in Florida: Sebring; West Palm Beach.

Remarks: The specimens of *Aspidiotus cyanophylli* Sign. from West Palm Beach, on hammock bay, collected by Mr. F. F. Bibby.

Dictyospermum Scale

Chrysomphalus dictyospermi (Morg.)

Scale of Female.—The scale of the female is from 1.25 mm. to

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2 mm. in diameter. It is slightly convex and varies from grayish-white to brown in color. The exuviae are central or subcentral and light yellow or orange in color. The central nipple is grayish, surrounded by a dark depressed area.

Scale of Male.—The scale of the male is similar to that of the female, but is more elongated. The exuviae are subcentral.

Plants found infested in Florida: apollo laurel; *Arbor vitae;* avocado; banana; Barbados cherry *(Malpighia glabra); Camellia japonica;* *camphor;* century plant; Chinese fan palm; cinnamon; citrus; cocoanut; creeping cypress; *Ficus altissima; Ficus eburnia; Ficus elastica;* guava; *Jasminum officinale; Kentia belmoreana;* Kenyon palm; mango; Panama hat plant; *Pandanus;* pecan; Phoenix palm; poinsettia; privet; *Rheedia aristata;* rose; royal palm; *Sabal blackburniana; Sabal havanensis;* Sago palm.

Fig. 19.—English Walnut Scale, *Aspidiotus juglans-regiae* Comst., on *Liquidamber styraciflua.* Enlarged twice. (Original.)

Other plants liable to become infested: *Cycas; Dictyospermum album; Erythrina indica; Latania.*

Distribution in Florida: Clearwater; Fort Pierce; Gainesville; Homestead; Jacksonville; Key West; Larkin; Miami; Ocala; Oneco; Orlando; Palm Beach; Pensacola; Saint Leo; Sarasota; Sebring; Tampa.

English Walnut Scale
Aspidiotus juglans-regiae Comst.

Scale of Female.—The scale of the female is flattened and circular and is from 2.5 mm. to 3 mm. in diameter. The color varies from light gray, on English walnut, to dark reddish brown or black when on plum or peach. The color so harmonizes with the bark in some cases as to make it difficult to distinguish. The exuviae are central or subcentral and covered with a secretion.

Scale of Male.—The scale of the male is like that of the female, but more elongated and smaller. The exuviae are, for the most part, at or near the anterior end.

Plants found infested in Florida: English walnut; peach; plum; tulip poplar.

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Other plants liable to become infested: apple; elm, hackberry, prickly ash; rose; sweet gum; white ash.

Distribution in Florida: Bellair; Dade City; Gainesville; Lutz; Olustee; Oneco; Tampa.

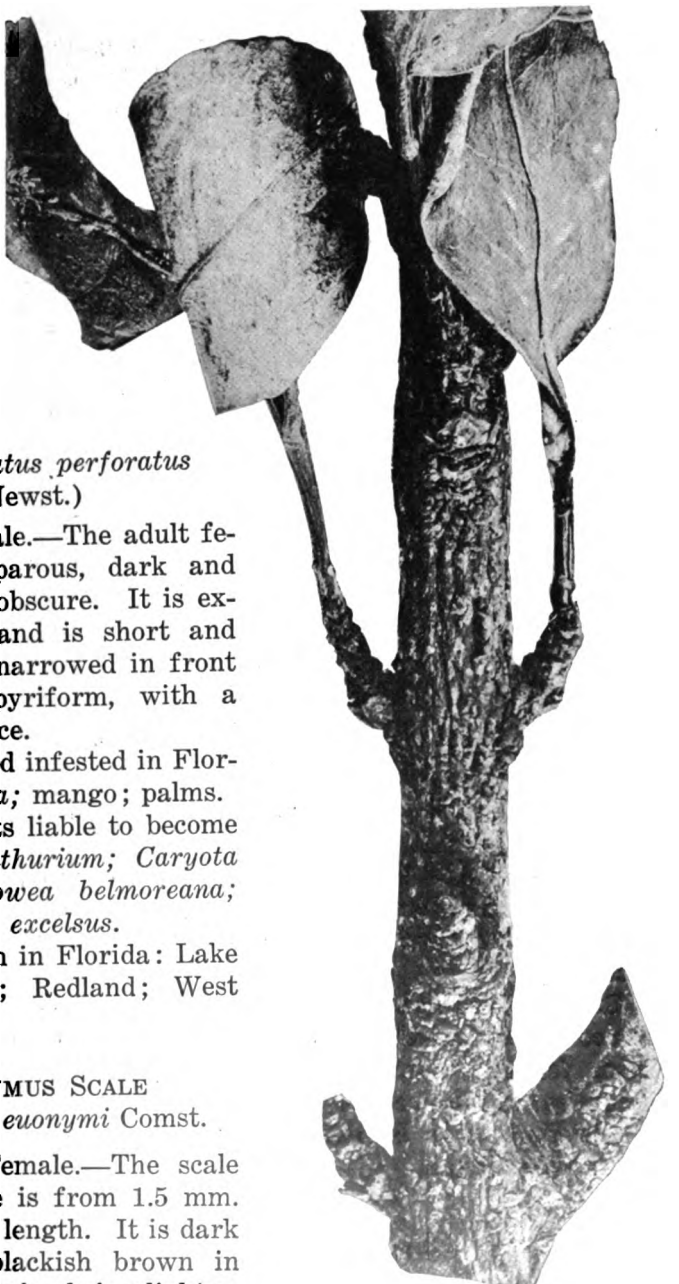

Fig. 20.—Euonymus Scale, *Chionaspis euonymi* Comst., on *Euonymus*. Enlarged twice. (Original.)

Eucalymnatus perforatus (Newst.)

Adult Female.—The adult female is viviparous, dark and more or less obscure. It is extremely flat and is short and ovate. It is narrowed in front or broadly pyriform, with a shining surface.

Plants found infested in Florida: *Eugenia;* mango; palms.

Other plants liable to become infested: *Anthurium; Caryota cumingii; Howea belmoreana; Trachycarpus excelsus.*

Distribution in Florida: Lake City; Miami; Redland; West Palm Beach.

EUONYMUS SCALE

Chionaspis euonymi Comst.

Scale of Female.—The scale of the female is from 1.5 mm. to 2.2 mm. in length. It is dark grayish or blackish brown in color, the margins being lighter. It is broadened posteriorly.

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Scale of Male.—The scale of the male is white. It is tricarinate and smaller than the female.

Plants found infested in Florida: *Euonymus japonicus.*

Other plants liable to become infested: *Celastrus scandens; Euonymus atropurpureus; Euonymus europaeus; Euonymus latifolia;* orange.

Distribution in Florida: Pensacola.

European Fiorinia
Fiorinia fioriniae (Targ.)

Scale of Female.—The scale of the female is thin, transparent and brownish yellow in color. The sides, which are almost par-

Fig. 21.—The European Fiorinia, *Fiorinia fioriniae* (Targ.), on hammock bay. Enlarged twice. (Original.)

allel, are elongated, hard and chitinous. The diameter is from 1 mm. to 1.25 mm. (1/25 inch to 1/16 inch).

Scale of Male.—The scale of the male is similar to that of the female, but smaller.

Plants found infested in Florida: *Camellia japonica;* hammock bay.

Other plants liable to become infested: *Anthurium acaule; Areca aurea;* camellia; cocoanut palm; *Cupressus; Cycas revoluta;* ferns; *Ficus; Hedera helix; Leptospermum; Livistona; Phytelephas macrocarpa; Podocarpus.*

Distribution in Florida: Jacksonville; Oneco; Tallahassee; West Palm Beach.

Florida Red Scale
Chrysomphalus aonidum (Linn.)

(Fig. 22)

Scale of Female.—The scale of the female is circular and

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Fig. 22.—Florida Red Scale, *Chrysomphalus aonidum* (Linn.), on *Arbutrius*. Enlarged twice. (Original.)

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convex. In color it is dark reddish-brown to almost black. The exuviae are central, bright yellow in color and form a central, grayish-white nipple.

Scale of Male.—The scale of the male is similar to that of the female, but smaller and lighter in color.

Plants found infested in Florida: apollo laurel; *Aralia; Areca aliceae; Areca triandra;* Australian plum; avocado; camphor; *Cedrela odorata; Chamaedorea;* cherry laurel; cinnamon; citrus; *Cocos plumosa; Dictyosperma album; Dictyosperma rubrum; Dypsis madagascariensis; Eucalyptus; Ficus elastica;* German ivy; guava; *Hyophorbe;* jasmine; *Kentia fostercana; Latania;* magnolia; Mammea apple; mango; mulberry; oleander; palm; *Pandanus; Phoenix cananensis;* pecan; poinsettia; ponderosa lemon; privet; *Rhyncospernum; Roscheria melanochaetes;* rose; royal palm; sago palm; *Seaforthia;* screw-pine; sour sop; sweet olive; traveler's tree; *Washingtonia robusta.*

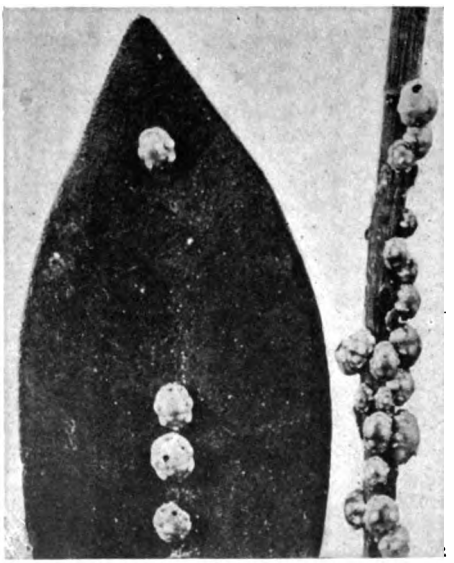

Fig. 23.—Florida Wax Scale, *Ceroplastes floridensis* Comst., on bay. Enlarged twice. (Original.)

Plants liable to become infested: Begonia; camellia; *Ilex latifolia;* rhododendron.

Distribution in Florida: Generally distributed over the State.

Florida Wax Scale

Ceroplastes floridensis Comst.

Adult Female.—The adult female is from 2.5 mm. to 3 mm. in length. It is covered by a waxy excretion. The color is usually brownish on the dorsal surface and dirty white, yellowish white or brownish on the sides.

Plants found infested in Florida: apple; avocado; box wood; cape jasmine; cherry laurel; Chinese holly; cinnamon; citrus; *Coccolobis; Cryptostegia; Euonymus;* fern; *Ficus aurea; Ficus elastica;* French mulberry; gall berry; *Gordonia lasianthus;*

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guava; Japan plum; loquat; mango; myrtle; oleander; peach; pine; Pittosporum; plum; quince; red bay; sweet potato; tea; *Triplaris.*

Plants liable to become infested: *Andromeda; Anona reticulata; Anthurium; Ilex glabra; Magnolia fuscata;* pomegranate.

Distribution in Florida: Generally distributed over the State.

The Gloomy Scale
Chrysomphalus tenebricosus (Comst.)

Scale of Female.—The scale of the female is 1.5 mm. in diameter. It is circular, very convex and of a dark gray color, resembling the bark on which it rests. The surface of the scale is rough. The exuviae are central and are surrounded by a gray ring.

Scale of Male.—The scale of the male is similar to that of the female, but oval. The exuviae are near the anterior end.

Host plants found infested in Florida: *Acer rubrum;* gall berry.

Plants liable to become infested: apple; box elder; cottonwood; hackberry; mulberry; oak; poplar; silver maple.

Distribution in Florida: Fort Pierce; Macclenny.

Fig. 24.—The Gloomy Scale, *Chrysomphalus tenebricosus* (Comst.), on *Acer rubrum.* Slightly enlarged. (Original.)

Remarks: The specimens of *Chrysomphalus tenebricosus* (Comst.) were collected by Mr. F. F. Bibby.

The Grape Scale
Aspidiotus uvae Comst.
(Fig. 25)

Scale of Female.—The scale of the female is from 1.5 mm. to 2 mm. in diameter. The scale is nearly circular, quite flat and thin. In color the scale is light brown or light yellowish-brown, and rather conspicuous, because of the darker color of the grape vine. The exuviae are light yellow in color and subcentral in position. The ventral scale is thin and adheres to the bark when the insect is removed.

Scale of Male.—The scale of the male is slightly darker in

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color than the female. It is elongated and has the exuviae near one end.

Plants found infested in Florida: grape; hickory.

Distribution in Florida: Macclenny.

Remarks: The only specimens of *Aspidiotus uvae* received were collected by Mr. E. K. Bynum at Macclenny, Fla.

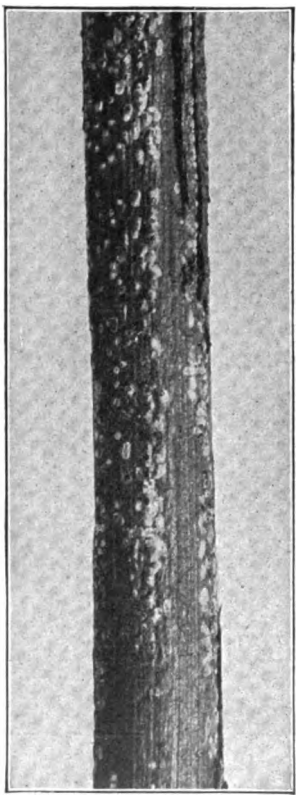

Fig. 25.—The Grape Scale, *Aspidiotus uvae* Comst., (from the 8th Ann. Rept. State Entomologist of Indiana, p. 305.)

Greedy Scale
Aspidiotus camelliae (Sign.)

(Fig. 26)

Scale of Female.—The scale of the female is about 3-50ths inch (1.5 mm) in diameter. It is thin and convex and gray or blackish in color. The exuviae are subcentral and dark brown or black in color.

Scale of Male.—The scale of the male is similar to that of the female, but not so convex. It is more elongated and smaller.

Plants found infested in Florida: avocado; bay; camphor; cherry laurel; *Euonymus japonicus;* guava; *Magnolia grandiflora; Melia azadarach;* morning glory; palm; *Plumiera;* privet; water oak.

Other plants liable to become infested: *Acacia;* almond; apple; birch; buck bush; *Camellia;* camphor; *Cercis;* cherry; *Cissus; Coprosma;* cottonwood; English ivy; English walnut; eucalyptus; fig; *Fuchsia; Genista;* grape; heath; holly; honey-locust; laurel; *Lavatera;* lemon; maple; mistletoe; mountain holly; *Myoporum;* myrtle; nightshade; olive; orange; passion vine; pear; pepper tree; *Pittosporum;* pomegranate; quince; redbud; *Rhamnus crocea;* rose; sage; *Sedum;* silver tree; *Strelitzia;* tea; walnut; willow; yam.

Distribution in Florida: Cocoanut Grove; Ft. George; Ft. Pierce; Gainesville; Glen St. Mary; Oneco; West Palm Beach.

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GREENHOUSE ORTHEZIA
Orthezia insignis Douglas
(Fig. 27)

Adult Female: The body of the adult female is broadly oval, having a width of about 1.5 mm. to 2 mm. The length is about 1.5 mm. It is usually dark green in color, but older specimens become blackish. With the exception of the head it is surrounded by a marginal series of snow-white lamellae or waxy plates. These plates increase in length posteriorly and point backward, with the exception of the first three on each side. The antennae have eight joints. The legs are light brown and bear numerous spines.

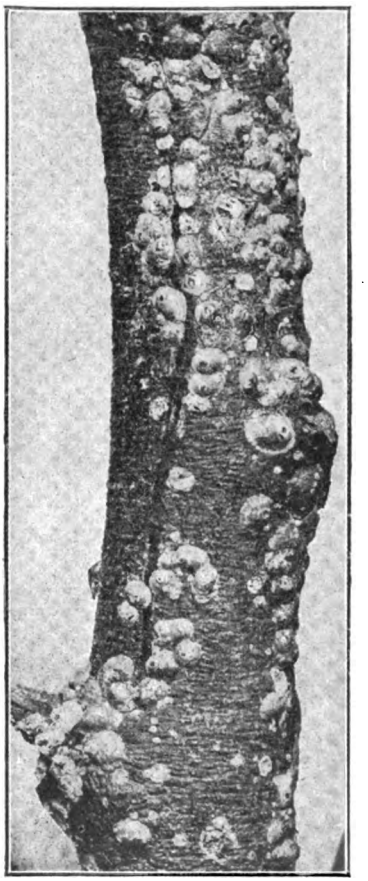

Fig. 26.—The Greedy Scale, *Aspidiotus camelliae* (Sign.) (After Essig., Injurious and Beneficial Insects of California.)

Plants found infested in Florida: iron weed.

Other plants liable to become infested: *Achillae; Ageratum; Bignonia; Capsicum;* chrysanthemum; citrus; coleus; *Cuphea; Gardenia; Ipomoea;* ironweed; *Lantana; Lonicera;* moonflower; pepper; pigweed; sage; *Salvia;* strawberry; *Strobilanthes;* tea; *Thunbergia;* tomato; verbena; *Vernonia;* yarrow.

Distribution in Florida: Oneco.

Remarks: This species is a very serious greenhouse pest. The specimens of *Orthezia insignis* were collected by F. W. Poos, Jr., at Oneco, Fla.

GREEN SHIELD SCALE
Pulvinaria psidii Mask.
(Fig. 28)

Adult Female.—The adult female is ovoid, convex above and elevated behind by a cottony egg-sac, which eventually projects

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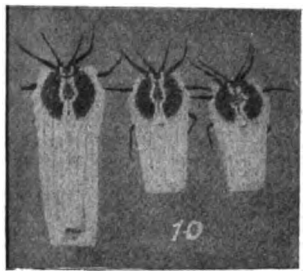

Fig. 27.—The Greenhouse Orthezia, *Orthezia insignis* Dougl. (After Sanders, Journ. Ec. Ent. Vol. II.)

on all sides. It is green in color and more or less obscured by a white, powdery secretion. The length of the scale is from 2 mm. to 4 mm. (1/12 inch to 1/6 inch).

Plants found infested in Florida: *Antidesma;* Australian silk oak; avocado; cape jasmine; citrus; *Clerodendrum; Coccolobis; Cupani sapidia; Ficus aurea; Ficus australis; Ficus benjamina; Ficus elastica; Ficus indica; Ficus macrophylla;* fiddle-wood; guava; hibiscus; *Macrophylla;* mango; mastic; *Nephelium longanum;* rose apple; *Sapodilla;* sea grape; *Solonum* sp., *Warneria thunbergia;* wax myrtle; yellow elder.

Other plants liable to become infested: *Eurya japonica;* ferns; *Pittosporum;* plum.

Distribution in Florida: Arch Creek; Bradentown; Cocoanut Grove; Fort Myers; Fort Pierce; Homestead; Little River; Miami; Oneco; Palm Beach; Pompano; St. Petersburg; Sebring; West Palm Beach.

GROUND PEARL
Margarodes formicarium Guilding

Adult Female.—The adult female is enclosed in a globular horny shell, and resembles a small pea

Fig. 28.—Green Shield Scale, *Pulvinaria psidii* Mask., on *Ficus aurea*. Enlarged twice. (Original.)

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in shape and size. In color, it is a light yellowish-brown. The general appearance resembles a pearl. It is usually found on roots of plants near an ant's nest.

Plants liable to be found infested: corn; sugar cane and allied plants.

Distribution in Florida: Key Largo.

Remarks: This scale has not been received by the author, but was reported from Key Largo in 1907.

Hemisphaerical Scale
Saissetia hemisphaerica (Targ.)

Adult Female.—The adult female is from 2 mm. to 3 mm. (about 1/8 inch to 3/16 inch) in diameter. The color varies from light to dark brown. The scale is more or less hemisphaerical in shape, convex on dorsal surface, smooth and shining.

Plants found infested in Florida: *Arbor vitae;* asparagus fern; avocado; *Claucera lausium; Cycas;* fern; *Jacaranda mimisaefolia; Lagerstroemia;* oleander; *Philibertella clausa; Prosopis juliflora; Rheedia aristata; Rheedia edulis;* Sago palm; *Tabernae montana; Zamia.*

Other plants liable to become infested: *Aloe:* asparagus; *Begonia; Camellia;* chrysanthemum; citrus; *Cocos; Croton variegatum; Ficus;* guava; mountain holly; orchids; palms; peach; pepper tree; rose.

Distribution in Florida: Ft. Myers; Gainesville; Homestead; Lake Wales; Oneco; Redland; Rockledge; St. Petersburg; Silver Palm; Tampa; West Palm Beach.

Hemlock Scale
Aspidiotus abietis (Schr.)

Scale of Female.—The scale of the female is from 1/20 inch to 2/25 inch (1.3 mm. to 2 mm.) in length. The scale is elongated and the sides are almost parallel, the ends being rounded. The exuviae is orange color and the color of the scale is dark gray or black with the margins lighter.

Fig. 29.—Hemisphaerical Scale, *Saissetia hemisphaerica* (Targ.), on Sago palm. Slightly enlarged. (Original.)

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Scale of Male.—The scale of the male is similar to that of the female, but is smaller and slightly darker.

Plants found infested in Florida: short leaf pine.

Other plants liable to become infested: fir; hemlock; maple; pines.

Distribution in Florida: West Palm Beach.

Remarks: This species was collected by Mr. F. F. Bibby, near West Palm Beach, Florida.

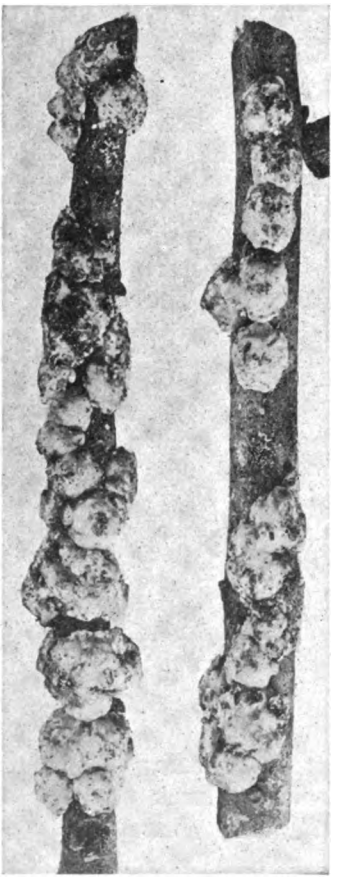

Fig. 80.—Japanese Wax (or Mexican Wax) Scale, *Ceroplastes ceriferus* (Anderson), on persimmon. Enlarged twice. (Original.)

Japanese Wax Scale

Ceroplastes ceriferus (Anderson)

Scale of Female.—The diameter of the scale of the female is from 3 mm. to 5 mm. The bodies are covered with a thick, white wax that gives a greasy appearance. The body is black or purplish brown and is indistinctly seen through the wax.

Scale of Male.—The scale of the male is from 2 mm. to 2.5 mm. in length. It is opaque and glassy white.

Plants found infested in Florida: gumbo limbo; wild persimmon.

Other plants liable to become infested: *Camellia; Gardenia;* hibiscus; mango; *Melaleuca;* Myrica cerifera; orange; tea.

Distribution in Florida: Dundee; West Palm Beach; Winter Haven.

Remarks: Specimens of *Ceroplastes* collected at West Palm Beach, Florida, were severely infested with *Laetilia coccidivora.*

Kermes galliformis Riley

"A large dark dirty-gray form, which turns to a nearly white color when exposed a season on the twigs. Female scale 6 mm. long, 7 mm. broad, 6 mm. high, with black spots, and viewed with a hand-lens, the scale is seen to be covered with minute black specks. Newly hatched larvae dirty-gray."

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Plants found infested in Florida: live oak.

Other plants liable to become infested: white oak.

Distribution in Florida: Bradentown; Gainesville; Tampa; West Palm Beach.

Remarks: The above description is taken from King (Psyche IX, p. 79, 1900).

Fig. 31.—Lataniae Scale, *Aspidiotus lataniae* Sign., on chinaberry *(Melia azadarach.)* Enlarged twice. (Original.)

Lataniae Scale
Aspidiotus lataniae Sign.

Scale of Female.—The scale of the female is almost circular when found singly, but is rather irregular and elongated in form when clustered together. The diameter is from 1.5 mm. to 2 mm. It is convex and the color varies from light yellow to dirty white, the central portion being dark. The exuviae are large, central or subcentral in position and pale brown or yellow in color.

Scale of Male.—The scale of the male is similar to that of the female in color, but is smaller and elongated.

Plants found infested in Florida: *Artocarpus;* avocado; bamboo briar; camphor; cherry laurel; chinaberry; cinnamon; cocoanut; *Cocos bonneti; Ficus* sp.; gall berry; guava; juniper; loquat; mango; matrimony vine; *Melaleuca nesophila;* palm; pecan; persimmon; poison ivy; quince; rose; sweet gum; sweet olive; witch hazel.

Other plants liable to become infested: *Areca lutescens;* cottonwood; *Scalesia.*

Distribution in Florida: Apalachicola; Astatula; Avon Park; Bradentown; Clearwater; Cocoanut Grove; Ft. Myers; Ft. Pierce; Gainesville; Glen St. Mary; Inverness; Jacksonville; Lakeland; Macclenny; Miami; Oneco; Orlando; Palatka; Palm Beach; Pensacola; Redland; Sebring; Tallavast; Tampa; West Palm Beach.

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Lecaniodiaspis tessellatus Ckll.

"Female.—Scale nearly circular, moderately convex; long. 4½, lat. 4, alt. 2 mm.; above dull red-brown, not very dark with dull white secretion forming lines, indistinct in middle, but at the sides forming regular pentagons, with an oval or elongate medium patch in each, arising from the margin of the scale. These pentagonal areas are eleven in number on each side, they are pointed mesad, the two shortest sides being the mesad ones, and the lateral side being formed by the margin of the scale. The lines of secretion indicate, but do not complete, three dorsal rows of enclosed areas, thus five rows in all. The enclosed areas are quite flat, not raised into little tubercles as in some species."

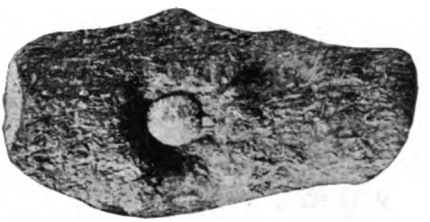

Fig. 32.—*Lecaniodiaspis tessellatus* Ckll., on hickory. Enlarged twice. (Original.)

Plants found infested in Florida: hickory.

Other plants liable to become infested: oak; pecan.

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell's original description in Entomological News, Vol. VIII, Number 7, 1897. The specimens were collected by Prof. P. H. Rolfs on hickory *(Carya porcina* Nutt) at Lake City, Florida.

Fig. 33.—*Lepidosaphes alba* (Ckll.), on *Manihot aipi*. Slightly enlarged. (Original.)

Lepidosaphes alba (Ckll.)

"Scale of Female.—The scale of the female is about 2½ mm. long, elongate, narrow, mytiliform, convex, sometimes curved. The scales vary much, some being quite long and narrow, others broad. Color grayish-white, the exuviae, which are of the usual size, reddish-brown. Several of the scales show holes where parasites have escaped.

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"The adult female is elongate, mytiliform, narrow anteriorly, with three blunt and wide lateral tubercles. Color brown."

Plants found infested in Florida: *Manihot aipi.*

Other plants liable to become infested: *Solanum.*

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell's original description in The Entomologist's Monthly Magazine, Vol. XXIX, p. 156 (1893).

Lepidosaphes nigra (Ckll.)

"Scale of the Female.—Scale 3½ mm. long (exuviae 1 1/3 mm.), pitch-black, with a narrow dull white margin; very narrow, very convex in a transverse direction, with a dorsal keel;

Fig. 34.—Lesser Snow Scale, *Hemichionaspis minor* (Mask.), on chinaberry (*Melia azadarach*). Natural size. (Original.)

exuviae elongated, half of the first skin on second, first skin dull orange, second skin dull dark reddish-brown."

Plants found infested in Florida: cabbage palmetto.

Other plants liable to become infested: *Agave;* laurel tree; *Yucca.*

Distribution in Florida: Ft. Pierce.

Remarks: The specimens of *Lepidosaphes nigra* (Ckll.) were collected on cabbage palmetto near Ft. Pierce, Florida, by Mr. F. F. Bibby. The above description is taken from T. D. A. Cockerell's original description in Biol. Cent. Amer. Vol. II, Part 2, p. 32, (Dec. 1899).

LESSER SNOW SCALE

Hemichionaspis minor (Mask.)

Scale of Female.—The scale of the female is from 1.8 mm. to 2.5 mm. in length. It is elongated and broadened posteriorly. It is rather thick in texture and white in color. The exuviae are yellowish-brown.

Scale of Male.—The scale of the male is similar to that of the female, but distinctly tricarinate.

Plants found infested in Florida: *Areca;* camphor; china-

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berry *(Melia azadarach);* cocoanut palm; *Cocos; Croton sylvaticus;* ebony; fig; *Grevillea robusta;* hibiscus; mango; morning glory vine; mountain rose; royal poinciana; *Schizolobium excelsum;* sweet potato; *Vitis quadrangularis.*

Other plants liable to become infested: *Capsicum;* cotton; *Cycas revoluta;* oleander; orange; pepper.

Distribution in Florida: Bradentown; Cocoanut Grove; Fort Myers; Fort Pierce; Homestead; Miami; Oneco; Palm City; Palmetto; Sarasota; Tampa; West Palm Beach.

Leucaspis bambusae Kuw.

Scale of Female.—The scale of the female is from 2 mm. to 3 mm. in length. The sides are nearly parallel, but broadened posteriorly. The scale is for the most part straight, but is

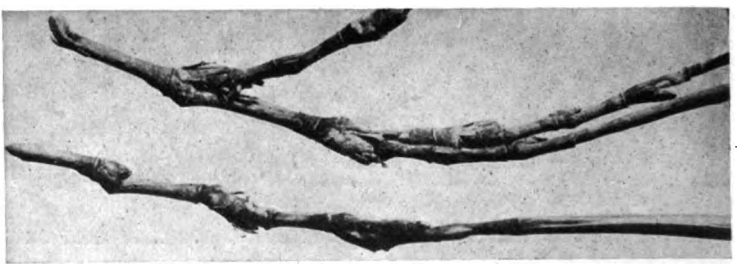

Fig. 35.—*Leucaspis bambusae* Kuw., on *Phyllostachys bambusodes.* Enlarged twice. (Original.)

sometimes curved. The scale is convex and rather thick in texture. The color is snow-white or light gray. The exuviae is large and is light or dark brown in color.

Plants found infested in Florida: *Phyllostachys bambusodes.*

Other plants liable to become infested: bamboo.

Distribution in Florida: Brooksville.

Remarks: Specimens of *Leucaspis bambusae* were collected by Mr. U. C. Zeluff in the Bureau of Plant Industry Plant Introduction Station at Brooksville, Florida. Additional specimens were collected by Mr. C. M. Hunt on request.

Long Scale or Glover's Scale
Lepidosaphes gloverii (Pack.)
(Fig. 36)

Scale of Female.—The scale of the female is light yellow to dark brown in color. It is elongate, broader posteriorly, and is 2 mm. (1/2 inch) in length. It is similar to *Lepidosaphes beckii.*

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Scale of Male.—The scale of the male is similar to that of the female, but is only about half as long.

Plants found infested in Florida: cabbage palmetto; cherry laurel; citrus; *Magnolia grandiflora.*

Other plants liable to become infested: *Magnolia fuscata;* palms.

Distribution in Florida: general.

Long-tailed Mealy Bug

Pseudococcus longispinus (Targ.)

Adult Female.—The length of the adult female is from 2.5 mm.

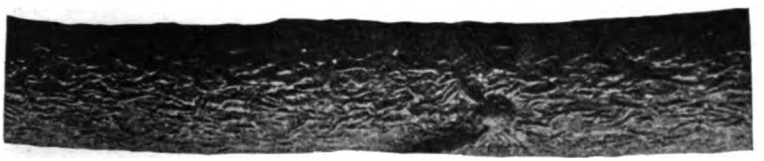

Fig. 36.—Long Scale or Glover's Scale, *Lepidosaphes gloverii* (Pack.), on orange. Enlarged twice. (Original.)

to 3 mm. (1/10 inch to 3/25 inch). It is light yellow or gray in color, and is covered by a fine, white, powdery wax. The lateral filaments are slender and short. The anal filaments are four in number and are long and conspicuous, the two inner ones being the longer.

Plants found infested in Florida: *Aralia;* avocado; bamboo; citrus; mango; palm; *Plumiera;* wax vine.

Other plants liable to become infested: begonia; calla; camellia; coleus; *Croton; Cycas revoluta;* ferns; *Ficus pandurata;* fig; grape; guava; moonflower; oleander; *Opuntia;* plum; Sago palm; umbrella plant.

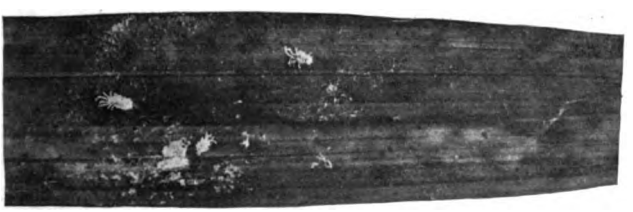

Fig. 37.—Long-tailed Mealy Bug, *Pseudococcus longispinus* (Targ.), on palm. Natural size. (Original.)

Distribution: The distribution is general over the State of Florida.

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Liriodendron Scale
Toumeyella liriodendri (Gmel.)

Adult Female.—The adult female is from 4 mm. to 7 mm. (3/16 inch to 3/8 inch) in diameter. It is circular or oblong in shape and strongly convex. The surface is irregular and the color varies from grayish-green to dark brown or black.

Adult Male.—The male is a small two-winged insect, yellowish-pink in color.

Plants found infested in Florida: *Gordonia lasianthus;* Loblolly bay; *Magnolia fuscata; Magnolia grandiflora; Magnolia soulangeana.*

Other plants liable to become infested: *Liriodendron tulipifera.*

Distribution in Florida: Clearwater; Cocoa; Dade City; Federal Point; Gainesville; Groveland; Lake Hamilton; Macclenny; Oneco; Orlando; Pensacola; Tampa.

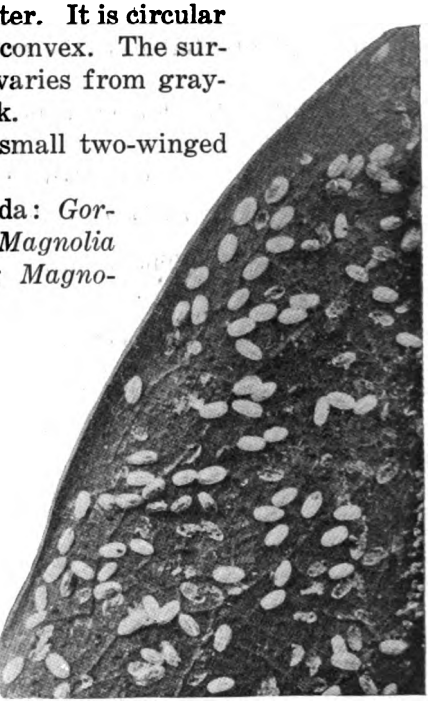

Fig. 38.—Liriodendron Scale, *Toumeyella liriodendri* (Gmel.), showing males on *Magnolia fuscata.* Enlarged twice. (Original.)

Remarks: Hymenopterous parasites, *Coccidoxenus mexicanus.* Girault, were reared from specimens collected at Gainesville, Fla. Specimens from Gainesville, Groveland, Lake Hamilton, Macclenny and Orlando were infested with the larva of a coccid-eating moth, *Laetilia coccidivora. Aschersonia cubensis* was found infesting the Gainesville specimens.

Mango Scale
Leucaspis indica Marlatt

Scale of Female.—The scale of the female is from .5 mm. to 1 mm. in length. It is narrow and flattened at the tip. The scale is convex and has a loosely adhering sack-like, white, waxy covering.

Fig. 39.—Liriodendron Scale, *Toumeyella liriodendri* (Gmel.), showing females on *Magnolia fuscata.* Enlarged twice. (Original.)

Plants found infested in Florida: mango.

Distribution in Florida: Buena Vista; Miami.

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Remarks: Specimens of *Leucaspis indica* usually occur massed in cracks or under loose bark, and resemble minute seeds or eggs.

Mango Shield Scale

Coccus mangiferae (Green)

(Figs. 40 and 41)

Scale of Female.—The scale of the female is yellowish green or brown in color. In shape it is deltoid, bluntly pointed in front

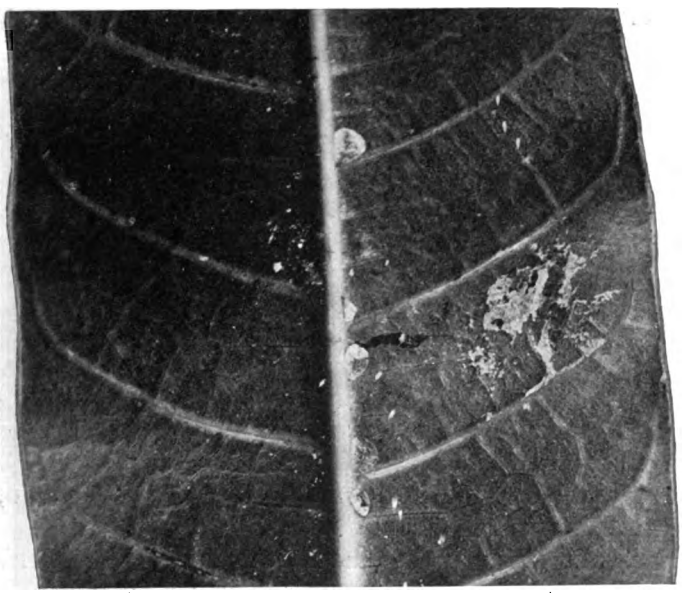

Fig. 40.—Mango Shield Scale, *Coccus mangiferae* (Green) on mango. natural size. (Original.)

and broadly rounded behind. It is very thin and flat and is irregularly marked with black. The length is from 3 mm. to 4 mm. and the width from 2.5 mm. to 3.5 mm.

Plants found infested in Florida: mango.

Other plants liable to become infested: alamanda; bread fruit; cinnamon; custard apple; Ixora; jasmine; nutmeg; Sapodilla.

Distribution: Arch Creek; Miami; Oneco; West Palm Beach.

Margarodes rileyi Giard.

Adult Female.—The adult female is found enclosed in a horny shell. In size and shape it resembles a small pea. The color is

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Fig. 41.—Mango Shield Scale, *Coccus mangiferae* (Green), greatly enlarged. (Original.)

light brownish yellow. This species is usually found closely associated with ants' nests.

Distribution in Florida: Florida Keys.

Remarks: Specimens of *Margarodes rileyi* Giard have not been received by the author, but have been reported as occurring on the Florida Keys.

Mining Scale
Howardia biclavis
(Comst.)

Scale of Female.—The scale of the female is almost circular in shape and is grayish or yellowish in color. The exuviae are marginal and are yellowish in color. The epidermal layer of bark from the host plant usually partly or wholly covers the scale, making it almost indistinguishable.

Male unknown.

Plants found infested in Florida: *Tabernae montana;* wisteria; white sapota *(Casimiroa edulis).*

Other plants liable to become infested: *Anona cherimolia; Anona muricata; Bixa orellono;* cinchona; coffee; *Ficus laurifolia; Flacourtia; Hybiscus aculeatus;* lime; *Microglossa zeylanica; Ochrea sapoti;* orange; tamarind; tea.

Distribution in Florida: Clearwater; Oneco; St. Petersburg.

Remarks: The specimens of this scale were collected in Clearwater, Florida, by Mr. U. C. Zeluff, on *Tabernae montana* and *wisteria.* Additional specimens were later collected by Mr. F. W. Poos, Jr., on white sapota at Oneco. Specimens of *Howardia biclavis* (Comst.) were taken at Miami, Florida, from a shipment of *Brumfelsia nitida* imported from Cuba.

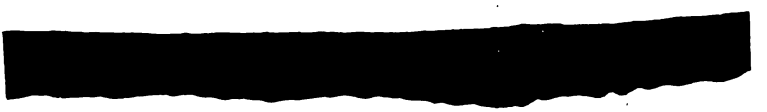

Fig. 42.—The Mining Scale, *Howardi biclavis* (Comst.), on *Tabernae montana,* natural size. (Original.)

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Neolecanium cornuparvum (Thro.)

"Female Scale.—The shape is elliptical and quite convex. The dorsal cuticle is shiny brown with a tinge of gray, and it is densely alveolate, with large glands. Length, 8-10 mm.; width, 5-8 mm. The spiracular grooves leave white dust when the insect is removed from the bark. The antenna is short and stout with six indistinct segments, and is of the vestigial type. The anal plate is two hundred and forty-eight microns long (the anal plate of *hesperidum* is two hundred microns long) and is two-thirds as broad as long, with the cephalo-lateral margin longer than the caudo-lateral, and both the lateral extremity and the apex rounded. There are five subapical and four apical setae. There are two large fringe setae, one on each ventral thickening and at least sixteen hypopigial setae. There are three short, stout spiracular setae subequal in length and about one-half as broad as long, with the medium setae notched at the apex. The marginal setae are short and conical. The legs are short and stubby with a small claw. It is viviparous, with the young scales, black. The dried young have a medium carina and many transverse carinae."

Fig. 43.—*Neolecanium cornuparvum* (Thro.), on *Magnolia grandiflora*. Enlarged twice. (Original.)

Plants found infested in Florida: *Magnolia grandiflora.*

Other plants liable to become infested: various species of magnolias.

Remarks: The writer is indebted to Prof. J. R. Watson of the Florida Experiment Station for this species. The above description is the original description of Thro.

OAK CHIONASPIS

Chionaspis quercus Comst.

Scale of Female.—The scale of the fe-

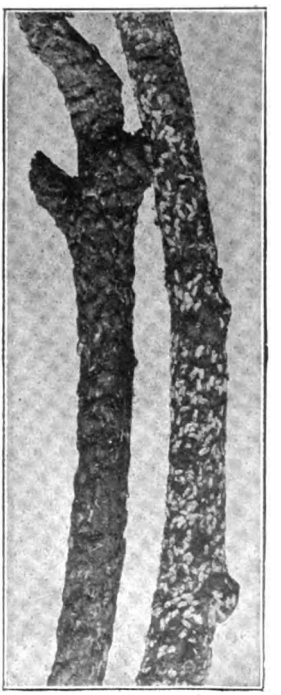

Fig. 44.—Oak Scale, *Chionaspis quercus* Comst. Enlarged twice. (After Essig, Injurious and Beneficial Insects of Cal.)

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Fig. 45.—Oak Ericoccus, *Ericoccus quercus* (Comst.), on oak. Enlarged twice. (Original.)

male is 2 mm. (2/25 inch) in length. It is long and narrowed at the anterior end. The posterior end is widened. The shape is convex, and the color is light to dark gray. The exuviae are brownish yellow. The scale is usually more or less covered by dirt or hairs of the stem to which it is attached.

Scale of Male.—The scale of the male is 1.25 mm. (1/20 inch) in length and is snowy white. The exuviae are light yellow.

Plants found infested in Florida: live oak; water oak.

Other plants liable to become infested: maul oak; white oak.

Distribution in Florida: Ft. Pierce; West Palm Beach.

Remarks: The specimens of *Chionaspis quercus* were collected by Mr. F. F. Bibby on live oak and water oak from Ft. Pierce and West Palm Beach.

Fig. 46.—The Obscure Scale, *Chrysomphalus obscurus* (Comst.), on oak. Enlarged twice. (Original.)

Oak Ericoccus

Ericoccus quercus (Comst.)

Female.—The body of the female is dark wine-colored and is enclosed in an oval, white, felt-like sac. It is 2.5 mm. (about 1/8 inch) in length.

Male.—The male is similar to the female, but smaller.

Plants found infested in Florida: gallberry; oak.

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Other plants liable to become infested: grass; *Vaccinium corymbosum.*

Distribution: Groveland; Jacksonville.

The Obscure Scale
Chrysomphalus obscurus (Comst.)
(Fig. 46)

Scale of Female.—The scale of the female is about 3 mm. in diameter. It is dark gray in color, resembling the color of the bark to which it is attached. It is slightly convex and almost circular. The exuviae are subcentral, forming a nipple-like projection, surrounded by a white ring.

Scale of Male.—The scale of the male is similar in color to that of the female, but is oval in shape.

Plants found infested in Florida: chestnut; live oak; water oak; wild myrtle.

Other plants liable to become infested: dogwood; grapevine; hickory; maple; pecan; willow oak.

Distribution in Florida: Bradentown; Ft. Pierce; Kissimmee; Macclenny; Palmetto; Sarasota; Sebring; Tampa.

Remarks: Some parasites were reared from specimens collected at Tampa, Florida.

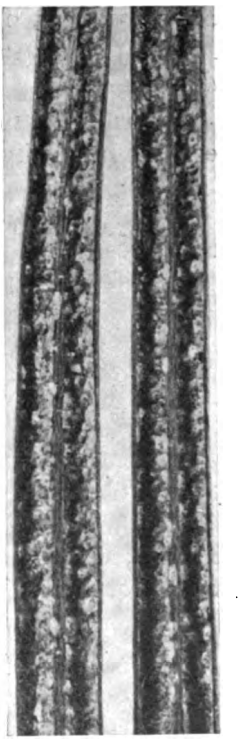

Fig. 47.—Oleander Scale, *Aspidiotus hederae* (Ball), on Sago palm. Enlarged twice. (Original.)

Oleander Scale
Aspidiotus hederae (Ball)

Scale of Female.—The scale of the female is almost circular, but when found on palms one side is usually flattened by coming in contact with a vein. It is from 1.5 mm. to 2 mm. in diameter. The scale is rather flat and is dull yellow to pearly white in color. The exuviae are central or subcentral and are light yellow to orange in color. They are covered in newly moulted specimens, but in older ones are bare.

Scale of Male.—The scale of the male is similar to that of the female, but is variable in form. It is usually elongated and white.

Plants found infested in Florida: *Areca;* Australian silk oak; avocado; camphor; chinaberry; *Coccolobis;* cocoanut palm;

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Cocos plumosa; English ivy; fan palm; jasmine; *Jatropha multifida;* mango; *Olea fragrans;* oleander; *Phoenix canariensis;* Sago palm; white bay *(Persea* sp.*)*.

Other plants liable to become infested: *Acacia; Agave palmeri; Alec umbellata; Amelia; Aroutus; Asparagus plumosus; Camellia; Carpodetus serratus; Cerceris;* clover; *Croton;* currant; *Cycas revoluta; Daphne gnidium;* English ivy; *Erica; Genista; Gertonia;* grass; holly; lemon; magnolia; maple; *Myrsine retusa;* olive; orange; orchids; palms; *Quercus ilex; Rubia peregrina; Ruscus aculeatus* sweet olive; *Vitex littoralis; Vriescia splendens;* Yucca.

Distribution in Florida: Astatula; Clearwater; Dundee; Federal Point; Gainesville; Jacksonville; La Grange; Lake Garfield;

Fig. 48.—Orange Chionaspis or Snow Scale, *Chionaspis citri* Comst., on orange. Enlarged twice. (Original.)

Miami; Oneco; Palm Beach; Port Tampa; Quincy; Rockledge; St. Petersburg; Tampa; West Palm Beach; Winter Haven.

Orange Chionaspis or Snow Scale

(Chionaspis citri Comst.*)*

Scale of Female.—The scale of the female is a dirty, blackish-brown color with a gray margin. The exuviae are a brownish yellow. The scale possesses a prominent central ridge from which the sides of the scale slope to the edge.

Scale of Male.—The scale of the male is small, long, narrow and white. The exuviae are yellowish.

Plants found infested in Florida: citrus.

Other plants liable to become infested: *Euonymus latifolius; Osmanthus;* palms.

Distribution in Florida: City Point; St. Cloud; Seffner; Tampa.

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Oyster-shell Scale
Lepidosaphes ulmi (Linn.)

Scale of Female.—The scale of the female is 2/25 inch (2 mm.) in length. It is dark colored, long and slender, often curved, widened posteriorly and resembles an oyster shell in shape. The exuviae are yellowish or yellowish-brown.

Scale of Male.—The scale of the male is similar to that of the female, but smaller and has the posterior part loosened for the exit of the male.

Plants found infested in Florida: peach.

Other plants liable to become infested: *Aesculus glabra;* apple; *Arlanthus glandulosus;* ash; birch; bladder-nut; butter-nut; *Ceanothus americanus; Cornus;* currant; Cysticus; elm; hawthorn; hop tree; linden; maple; oak; pear; plum; poplar; raspberry rose; *Sassafras officinale; Stillingia sebifera; Syringa persica;* water locust; wild cherry; willow; *Yucca.*

Distribution in Florida: Macclenny.

Fig. 49.—Oyster-shell Scale, *Lepidosaphes ulmi* (Linn.), on ash. Enlarged twice. Collected by Dr. E. W. Berger, Berea, O. (Original.)

Palmetto Scale
Comstockiella sabalis (Comst.)
(Fig. 50)

Scale of Female.—The scale of the female is from 1 mm. to 1.5 mm. in diameter. It is snowy white and irregular in outline, but approximately circular. The exuviae vary in position from central to marginal.

Scale of Male.—The scale of the male is similar to that of the female, but smaller and more elongated.

Plants found infested in Florida: cabbage palmetto; *Cocos;* cultivated spineless cactus; palmetto; *Sabal adamsonis; Sabal palmetto; Washingtonia robusta.*

Other plants liable to become infested: *Erytheaedulis.*

Distribution in Florida: Citra; Clearwater; Ft. George; Ft. Myers; Ft. Pierce; Oneco; Orlando; Palmetto; Redland; St. Petersburg;

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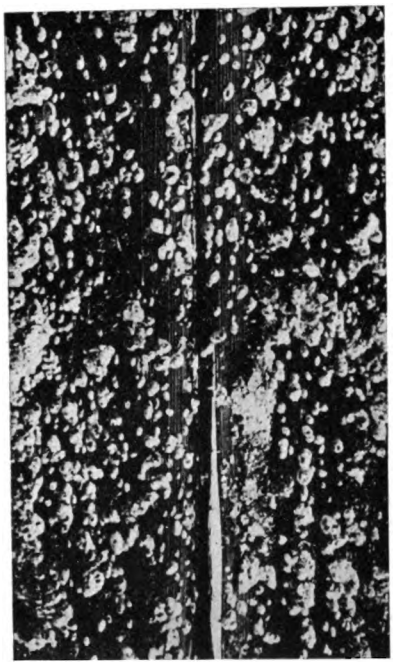

Fig. 50.—Palmetto Scale, *Comstockiella sabalis* (Comst.), on palmetto. Enlarged twice. (Original.)

Sanford; Sarasota; Tampa; Terra Ceia; West Palm Beach.

Palm or Tessellated Scale
Eucalymnatus tessellatus (Sign.)

Scale of Female.—The scale of the female is oval in shape, but broadly rounder posteriorly. It is of a dark brown color, with a decidedly mosaic appearance on the upper surface.

Scale of Male.—The scale of the male is not known.

Plants found infested in Florida: cocoanut palm; fish-tail palm; holly; palm; *Tabernae montana.*

Other plants liable to become infested: cinnamon; coffee; fern; laurel; *Laurus noblis; Lignum vitae;* orchid; rattan palm; *Sapidus saponaria.*

Distribution in Florida: Clearwater, Gainesville; Jacksonville; Little River; Oneco; Palm Beach; St. Petersburg; West Palm Beach.

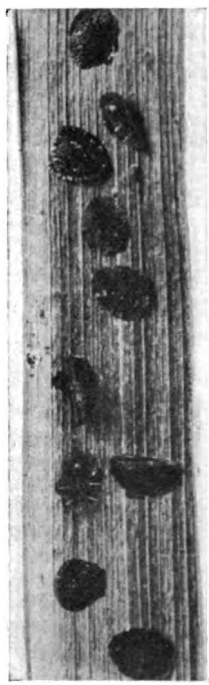

Fig. 51.—Palm or Tessellated Scale, *Eucalymnatus tessellatus* (Sign.), on cocoanut palm. Enlarged twice. (Original.)

The Parlatoria-like Scale
Pseudoparlatoria parlatorioides (Comst.)

(Fig. 52)

Scale of Female.—The scale of the female is 1.4 mm. (1/20 inch) in diameter. It is circular in shape with the exuviae marginal. The exuviae are large, extending from the margin to the center of the scale. The color of the scale is light yellow and the exuviae are a similar color or brownish.

Plants found infested in Florida: cabbage

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palmetto; camphor; cocoanut palms; mastic; *Persea carolinensis; Seaforthia; Washingtonia robusta.*

Other plants liable to become infested: *Drimys; Magnolia grandiflora; Oncidium varicosum;* peach; *Psidium.*

Distribution in Florida: Boynton; Ft. Myers; Manatee; Miami; Oneco; Palm Beach; Sebring; West Palm Beach.

Pineapple Mealy Bug
Pseudococcus bromeliae (Bouché)

Adult Female.—The adult female is from 2 mm. to 2.5 mm. in length. The color is pink. The body is sparsely covered with wax. The lateral filaments and legs are short. The body segments are distinct.

Plants found infested in Florida: pineapple.

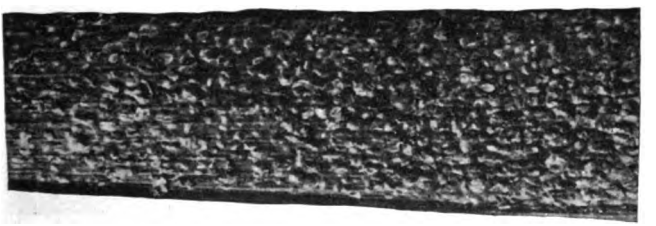

Fig. 52.—The Parlatoria-like Scale, *Pseudoparlatoria parlatorioides* (Comst.), on cabbage palmetto. Enlarged twice. (Original.)

Other plants liable to become infested: canna; hibiscus; mulberry.

Distribution in Florida: Delray.

Remarks: This species was collected by Mr. F. F. Bibby at Delray, Florida, on pineapples shipped from Cuba.

Pineapple Scale
Diaspis bromeliae (Kern.)
(Fig. 53)

Scale of Female.—The diameter of the scale is from 2 mm. to 2.5 mm. (7/100 inch to 9/100 inch) in length. It is circular and thin, and is white or light gray in color. The exuviae are light yellow.

Scale of Male.—The scale of the male is strongly carinate and white in color. The exuviae are yellow.

Plants found infested in Florida: pineapple.

Other plants liable to become infested: *Billbergia zebrina; Bromelia pinquin;* canna; hibiscus; ivy; *Olea fragrans.*

Distribution: Clearwater; Ft. Pierce; Oneco.

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The Pine-leaf Scale Insect
Chionaspis pinifolia (Fitch)

(Fig. 54)

Scale of Female.—The scale of the female is about 3 mm. (1/10 inch) in length. It is snowy white in color, usually long and narrow, but sometimes broad. The shape seems to depend upon the shape of the leaf to which it is attached. The exuviae are light yellow.

Scale of Male.—The scale of the male is slightly broadened

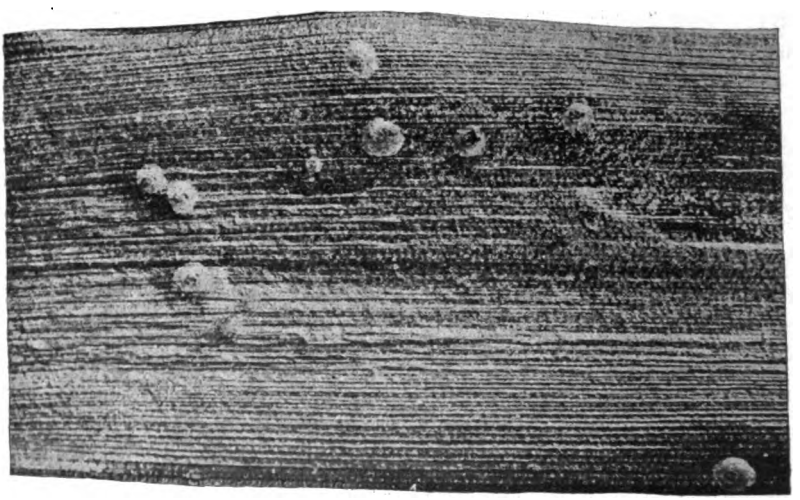

Fig. 53.—Pineapple Scale, *Diaspis bromeliae* (Kern.), on pineapple. Enlarged twice. (Original.)

posteriorly, and is about half the size of the female. The exuviae are pale yellow or colorless.

Plants found infested in Florida: juniper; pine.

Other plants liable to become infested: pine; spruce; other coniferous trees.

Distribution in Florida: Bradentown; Fort George; Gainesville; Palmetto; Sarasota.

Pine Scale
Chionaspis pinifoliae heterophyllae Cooley

This species is indistinguishable from *Chionaspis pinifoliae* except by the lobes of the pygidium. The scale is usually found near the base of the long leaves or on the bark of succulent twigs.

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Plants found infested in Florida: Cuban pine *(Pinus heterophylla); Pinus mitis.*

Other plants liable to become infested: pines.

Distribution in Florida: Ft. George; Gainesville; Palmetto; Winter Haven.

Pseudococcus calceolariae (Mask.)

"Adult Female.—The adult female is pink in color, and covered with a white meal. The body is pretty regularly oval, the segments very distinct; the appendages are short except at the posterior end where there are two very long, with, on each side of them, another somewhat shorter. The two longest surround the hairs of the anal tubercles; which are inconspicuous, and between them is visible the white pencil of meal surrounding the anal setae."

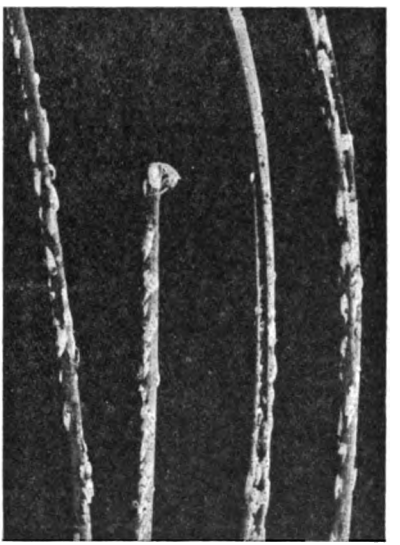

Fig. 54.—The Pine-leaf Scale-insect, *Chionaspis pinifolia* (Fitch), on pine. Enlarged twice. (Original.)

Plants found infested in Florida: sugar cane.

Other plants liable to become infested: *Calceolaria; Cordyline australis; Danthonia; Phormium tenax.*

Remarks: This species is reported as occurring in Florida, but has not been received by the author. The above description is taken from Maskell's original description, Transactions of the New Zealand Institute, XI, pp. 218-219 (1878).

Pseudococcus quaintancii (Tinsley)

"Adult Female.—Lengh 2 mm., width 1.5 mm., shape ellipsoidal, much flattened, color dark grayish-brown. The body is so covered with white secretion that its true color only shows on the ventral surface, the color of the dorsum appearing quite white. The white secretion mealy, projecting slightly on the lateral margins, but not forming well developed filaments; posteriorly it is produced into two very short, but well defined, caudal filaments; on the dorsum it is slightly raised into a

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longitudinal ridge. In addition to the mealy secretion, there is some fine, waxy, thread-like secretion. They produce no well-defined ovisac, only a fluffy mass of secretion."

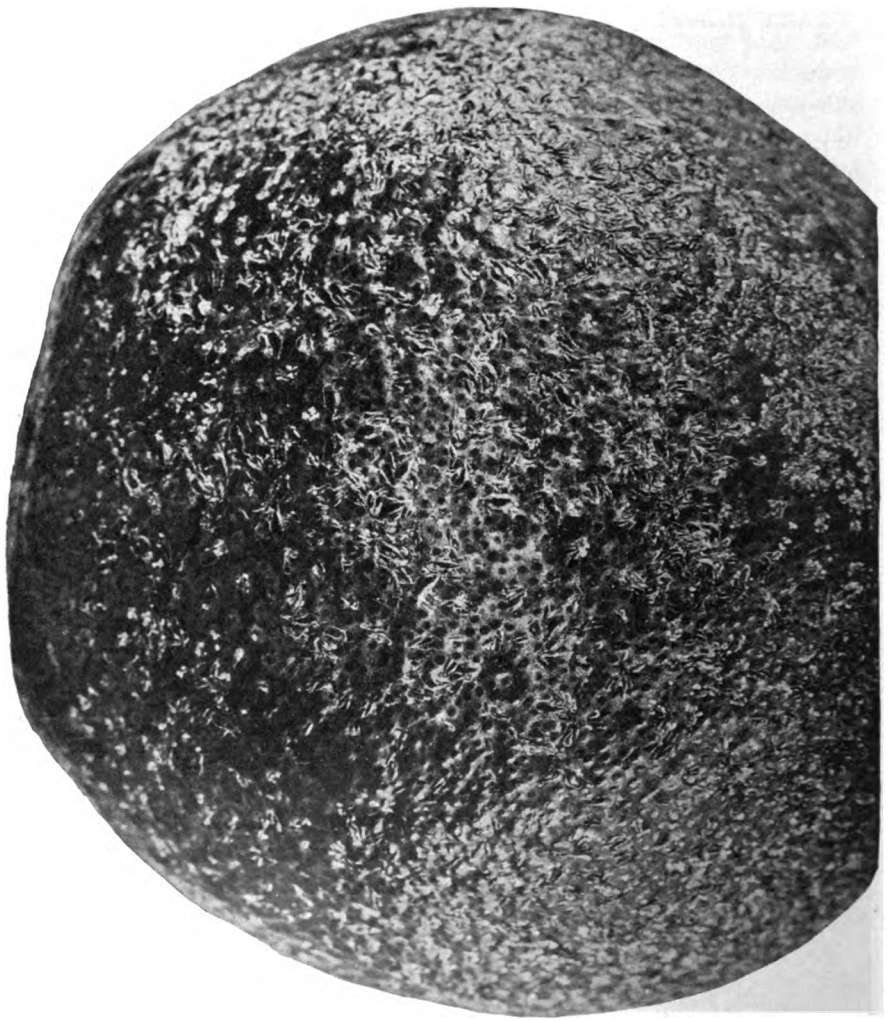

Fig. 55.—Purple Scale, *Lepidosaphes beckii* (Newm.), on orange. Enlarged twice. (Original.)

Remarks: The above description is from the Canadian Entomologist, Vol. XXX, page 220, 1898, from J. D. Tinsley's original description of specimens sent him by A. L. Quaintance from Lake City, Florida, on *Rhus copallina* L.

This species has not been received by the author.

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Purple Scale
Lepidosaphes beckii (Newm.)
(Fig. 55)

Scale of Female.—The scale of the female is from 2.5 mm. to 3 mm. (about 1/10 inch to 1/7 inch) in length. It is elongate and oyster shell shaped. The scale is slender and nearly straight (often curved when crowded). It is broader in the posterior portion.

Scale of Male.—The scale of the male is very similar to that of the female, but smaller.

Plants found infested in Florida: Chinese holly; citrus; Italian lemon; mango; oak; orange jessamine; pecan.

Other plants liable to become infested: *Banksia integrifolia; Cercidiphyllum japonicum; Croton; Elaeagnus;* fig; *Pomaderris apetala; Taxus cuspidata.*

Distribution in Florida: general.

Pustule Scale
Asterolecanium pustulans Ckll.

Scale of Female.—The scale of the female is from 1 mm. to 1.5 mm. in diameter. It is irregular in shape, usually oblong, but often circular. It is convex above and semitransparent. Fresh specimens are of a light yellowish green color or yellow with a pale pink fringe of hair-like projections around the edge. Dried specimens are a straw color. On oleander this scale lies in the sunken part of the pustule. The formation of pustules is not so noticeable on the other host plants as on oleander and fig.

Fig. 56.—Pustule Scale, *Asterolecanium pustulans* Ckll., on oleander. Enlarged twice. (Original.)

Plants found infested in Florida: Australian silk oak; custard apple; fig; *Grevillae robusta;* hibiscus; mango; mulberry; oleander; peach; persimmon.

Other plants liable to become infested: *Anona reticulata;* pigeon peas.

Distribution in Florida: Bradentown; Clearwater; Cocoanut Grove; Fort Pierce; Homestead; Lake Worth; Little River; Miami; Palmo Sola; Palmetto; Passagrille; Saint Petersburg; Seffner; Tampa; West Palm Beach; Winter Haven.

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Putnam's Scale
Aspidiotus ancylus (Putnam)

Scale of Female.—The scale of the female is approximately circular, although when found growing close together in groups, it is slightly longer than wide. The diameter is from 1 mm. to 1.5 mm. The exuviae are brick-red and are covered by a grayish or whitish excretion, which is easily removed. The remaining part of the scale is dark gray or almost black and has a slightly reddish tinge. The body of the female is yellow or orange yellow.

Fig. 57.—Putnam's Scale, *Aspidiotus ancylus* (Putnam), on peach. Natural size. (Original.)

Scale of Male.—The scale of the male is similar in color to the scale of the female, but slightly smaller and more elongated.

Plants found infested in Florida: chestnut; peach; pecan.

Other plants likely to become infested: apple; ash; beech; bladdernut; cherry; currant; elm; hackberry; hawthorne; linden; locust; maple; oak; osage orange; pear; plum; quince; snowball; tulip; willow.

Distribution in Florida: Bellair; Macclenny.

Pyriform Scale
Pulvinaria pyriformis Ckll.
(Fig. 58)

Adult Female.—The adult female is rounded or ovate, convex above and transversely corrugated. It is light to dark brown in color. The egg-sac is composed of white, cottony material, which eventually pushes out on all sides, leaving the scale resting on the cottony mass. The length is from 2 mm. to 4 mm. (1/12 inch to 1/6 inch).

Plants found infested in Florida: *Acalypha;* avocado; Cape jasmine; Chinese cinnamon; cinnamon; English ivy; grapefruit; guava; mango; *Rhyncospermum;* rose apple; *Sapodilla;* Star jasmine; *Warneria thunbergia.*

Other plants liable to become infested: *Caprifolia; Cordea.*

Distribution in Florida: Bradentown; Bridgeport; Clearwa-

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ter; Cocoa; Daytona; Elfers; Ft. Myers; Frostproof; Lakeland; Largo; Miami; Oneco; Orlando; Ormond; Ozona; Palm Beach; Pensacola; Rita; St. Cloud; St. Petersburg; San Antonio; Tampa; Tarpon Springs; West Palm Beach; Winter Haven; Winter Park.

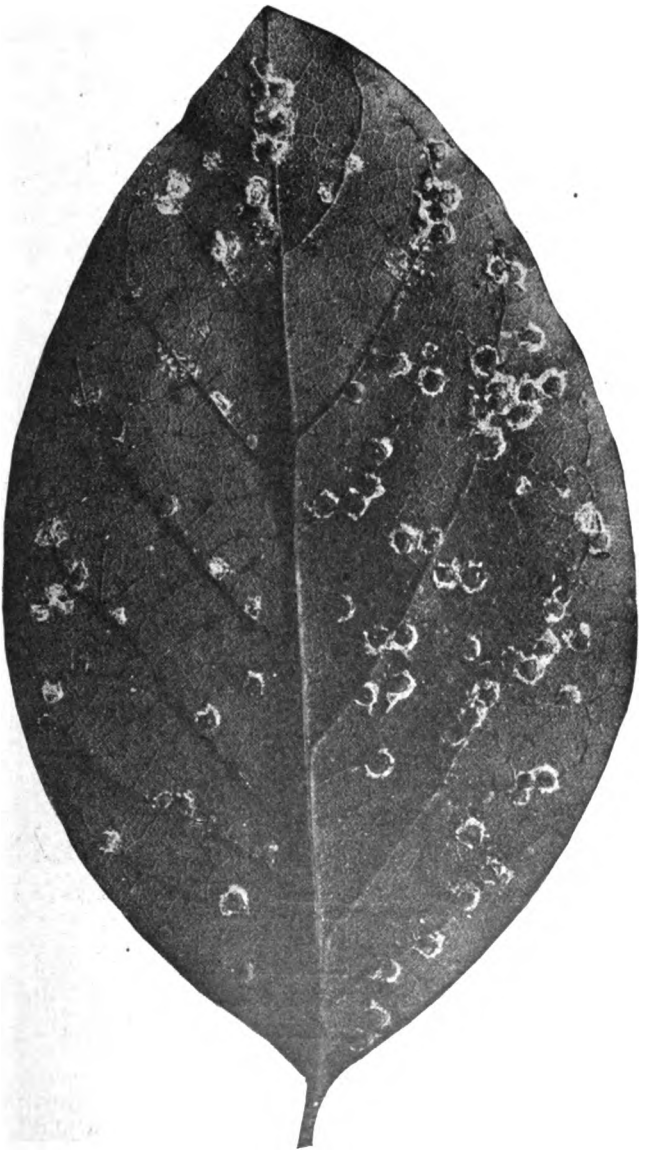

Fig. 58.—Pyriform Scale, *Pulvinaria pyriformis* Ckll., on avocado. Slightly enlarged. (Original.)

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Red Bay Scale

Chrysomphalus perseae (Comst.)

Scale of Female.—The scale of the female is from 3/50 inch

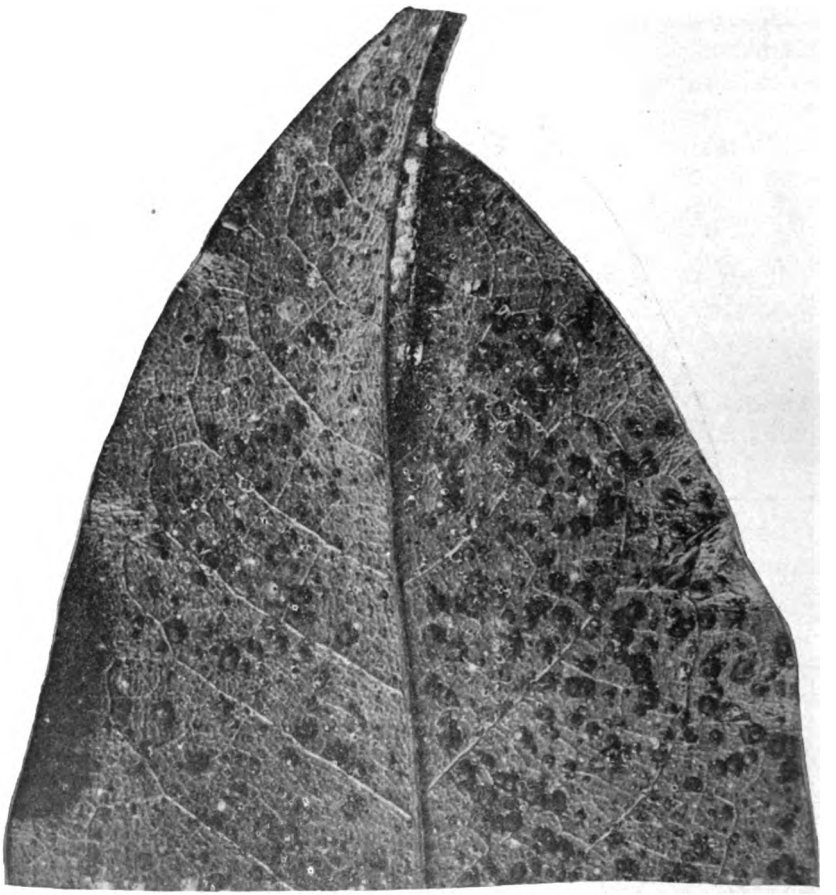

Fig. 59.—Red Bay Scale, *Chrysomphalus perseae* (Comst.), on *Magnolia grandiflora*. Enlarged twice. (Original.)

to 2/25 inch (1.5 mm. to 2 mm.) in diameter. It is flat and circular, and of a reddish brown color or almost black. The exuviae are nearly central in position and are dark gray or black in color.

Scale of Male.—The scale of the male is similar to that of the female, but is smaller and more elongate, with the black exuviae near the anterior end.

Plants found infested in Florida: cabbage palmetto; hammock

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bay; *Magnolia grandiflora;* olive; orchids; red bay *(Persea carolinensis);* short leaf pine.

Other plants liable to become infested: *Anthurium;* cocoanut palm; *Harrisii; Ilex; Magnolia glauca;* pine; *Viburnum.*

Distribution in Florida: Cedar Keys; Ft. Pierce; Gainesville; Lake City; Orlando; West Palm Beach.

Rose Scale
Aulacaspis rosae (Bouche)

Scale of Female.—The scale of the female is from 2 mm. to 3 mm. in diameter. It is circular or oval in single specimens, but when clustered is irregular in shape. It is thin and white or

Fig. 60.—Rose Scale, *Aulacaspis rosae* (Bouche), on rose. Natural size. (Original.)

grayish white in color. The exuviae are marginal or submarginal and light yellow to dull brown in color.

Scale of Male.—The scale of the male is elongated, narrow, white in color and tricarinate. The exuviae are terminal.

Plants found infested in Florida: rose.

Other plants liable to become infested: *Ailanthus;* blackberry; *Cycas;* mango; myrtle; pear; strawberry.

Distribution in Florida: Pensacola; Sanford.

The Rose Palaeococcus
Palaeococcus rosae (Riley & Howard)

(Fig. 61)

"Adult Female.—Similar in size to adults of *Icerya purchasi,* broadly oval in shape and densely covered with a short powdery secretion which forms a series of short close plaits around the margin. The waxy secretion has often a yellowish tinge. No distinctive egg-sac was to be found with any of the specimens received, and it is probable that such is not formed. Removing the secretion, the head and thorax are black, margined with red, while the dorsum of the abdomen and entire under side of the

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body are bright red; antennae, legs, and eyes black. Surface of the body covered with short hairs, lateral margin with longer hairs, still longer near anal end. Divisions of segments plainly marked, especially of abdomen, which has a broad rounded subdorsal ridge. On first issuing from the third stage the adult is only moderately convex, but advanced specimens are much swollen and appear more naked. The antennae are like those of *Icerya purchasi.*"

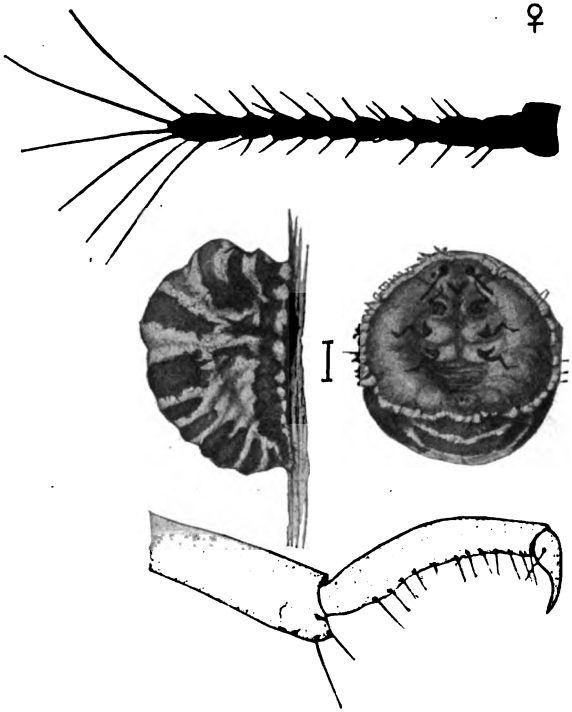

Fig. 61.—The Rose Palaecoccus, *Palaeococcus rosae* (R. & H.): Above, antenna of female; at left, pregnant female, side view; at right, same, ventral view; below, tarsus of female. (From Insect Life, Vol. III, p. 96, U. S. Dept. of Agr.)

Plants found infested in Florida: rose.

Other plants liable to become infested: *Amherstia noblis;* citrus; *Euphorbia; Hakea gibbosa; Lignumvitae; Prosopis julifera;* sugar apple.

Distribution in Florida: Key West.

Remarks: The above description is taken from "Insect Life" Vol. III, p. 96.

Rufous or West Indian Red Scale
Selenaspidus articulatus (Morg.)

(Fig. 62)

Scale of Female.—The scale of the female is from 2 mm. to 2.5 mm. in diameter. It is semitransparent, pale brown or yellowish-brown in color, with paler margins. The scale is flat and approximately circular. The exuviae are central or subcentral and yellowish or orange color.

Plants found infested in Florida: citrus; oleander.

Other plants liable to become infested: *Cordyline terminalis;*

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Dictyosperma album; Ficus; Gardenia; Ixora coccinea; palms; *Pandanus.*

Distribution in Florida: Key West.

Remarks: Specimens of this species were collected on lime in Key West, Florida, by Mr. H. M. McKay and specimens imported on shipments from Cuba were taken by Mr. A. C. Brown at Tampa, Florida.

San Jose Scale

Aspidiotus perniciosus Comst.

(Fig. 63)

Scale of Female.—The scale of the female is from 1 mm. to 2 mm. in diameter. It is circular in shape, slightly convex and

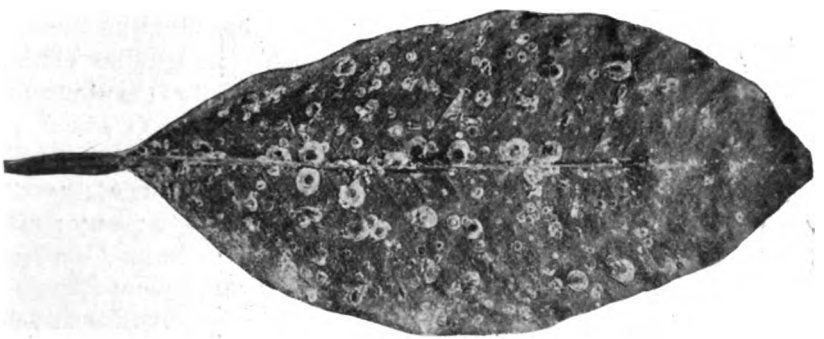

Fig. 62.—Rufous or West Indian Red Scale, *Selenaspidus articulatus* (Morg.), on lime. Enlarged twice. (Original.)

of a gray color. The exuviae are central or subcentral, pale yellow to reddish yellow or dark.

Scale of Male.—The scale of the male is oblong and dark, sometimes being black. The exuviae are subcentral. The length is usually about twice the diameter.

Plants found infested in Florida: apple; cherry; *Citrus trifoliata;* fig; flowering quince; laurel; lombardy poplar; peach; pear; pecan; plum; *Prunus carolina;* red osier; rose; *Siebaldiana;* wild crabapple.

Other plants liable to become infested: alder; apricot; ash; black walnut; Carolina poplar; catawba; cedar; chestnut; *Crataegus;* currant; dogwood; elm; English walnut; *Eucalyptus; Euonymus;* gooseberry; Japan walnut; laurel; linden; milkweed; persimmon; quince; raspberry; silver maple; *Spiraea;* spruce; strawberry; sumac; willow.

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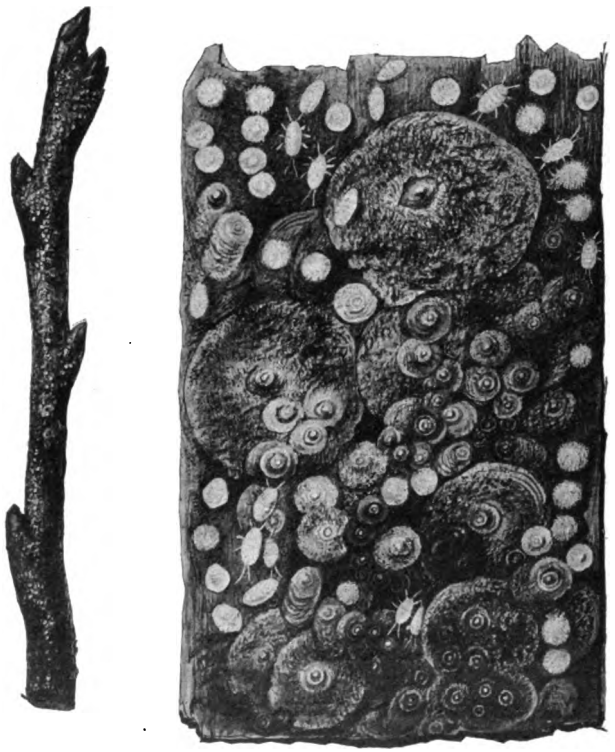
Soft Brown Scale

Coccus hesperidum (Linn.)

(Fig. 64)

Scale of Female.—The scale of the female is oval and flat. It is soft and more or less swollen and is yellowish or light brown in color. The young scales are transparent.



a b

Fig. 63.—Appearance of San Jose scale, *Aspidiotus perniciosus*, on bark; *a*, infested twig, natural size; *b*, bark as it appears under hand lens. (From Bul. No. 62, U. S. D. A., Bureau of Ent., Fig. 2, p. 35.)

Scale of Male. — The scale of the male is a yellow and very minute two-winged insect.

Plants found infested in Florida: apollo laurel; avocado; bay; citrus; *Croton;* ebony; English ivy; fern; fishtail palm; guava; jasmine; loquat; oleander; persimmon; *Philibertella clausa;* rose; royal palm; *Tabernae montana; Talinum* sp.; *Washingtonia robusta;* wisteria.

Other plants liable to become infested: *Camellia;* clematis; *Cycas revoluta;* holly; mimosa; *Morus nigra;* myrtle; oleander.

Distribution in Florida: generally distributed.

Sweet Gum Scale

Cryptophyllaspis liquidambaris Kotinsky

(Fig. 65)

Female Gall.—The female gall is found mostly on the upper

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side of the leaf and is from .5 mm. to 2 mm. high. The gall is bluntly conical in shape.

Female Scale.—The scale of the female is found mostly on the under side of the leaf. It is oval in shape, white in color and waxy in appearance. The central portion of the scale lies within the gall cavity immediately below the level of the surface of the leaf. The exuviae are large and lemon-yellow in color.

Scale of Male.—The scale of the male is similar to the scale of the female. Usually the male scales are found in groups around the glands of the leaf.

Plants found infested in Florida: red maple *(Acer rubrum);* sweet gum.

Distribution in Florida: Bradentown; Gainesville; Lutz; Macclenny; Palmetto.

Fig. 64.—Soft Scale, *Coccus hesperidum* (Linn.), on orange. (From Farmers Bul. No. 172, p. 30, Fig. 23.)

Toumeyella parvicornis (Ckll.)

"Adult Female. — Female scale about 5 mm. long, 4 broad and 3 high, of the ordinary Lecanium form, rather shiny; with irregular longitudinal series of conspicuous pits, one row on each side subdorsally, and two irregular and subconfluent rows laterally. Color of scale ochreous often with a pinkish tinge, with irregular black spots accompanying the rows of pits. Sometimes there are suffused blackish longitudinal bands in place of the spots. Under surface of female dull pink.

"The female, boiled in caustic soda, turns the liquid crimson. The eggs inside her turn bright crimson, strongly contrasting with her yellowish-brown skin. Mouth-parts very small for the size of the insect. Antennae short and broad, rudimentary, about 2½ times as broad, tipped with bristles, joints obscure. Legs equally rudimentary. Skin not tessellate, but with scattered gland-spots. The skin is very little chitinised, except in the anal region. Male scales ordinary, granular, more or less overlapping.

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"Newly hatched larvae oval, pale pinkish, with two very faint suffused longitudinal dorsal bands of darker color."

Plants found infested in Florida: pine.

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell's original description in Psyche, Vol. VIII, pp. 90-91 (1897).

Toumeyella turgida (Ckll.)

(Fig. 66)

"Scale of Female.—Scale of female 5½ mm. long, 4½ wide, 3¼ high. Dark reddish-brown, very shiny, swollen into irregular pustule-like prominence, with large punctiform depressions between.

"The female boiled in caustic soda, turns the liquid dark sepia, and gives a slight musky odor. Dermis chitinous, orange-brown, not reticulated, presenting numerous small gland spots. Marginal spines excessively minute. Mouth parts very small, rostral loop very short. Antennae very small, short and very stout, bristly at tip. Segmentation obscure. Legs, very small and stout. Coxa considerably broader than long; femur very broad, and not much longer than broad; tibia a little longer than tarsus, and about one fourth longer than broad. Claw short and stout, much curved. Digitules comparatively short, filiform.

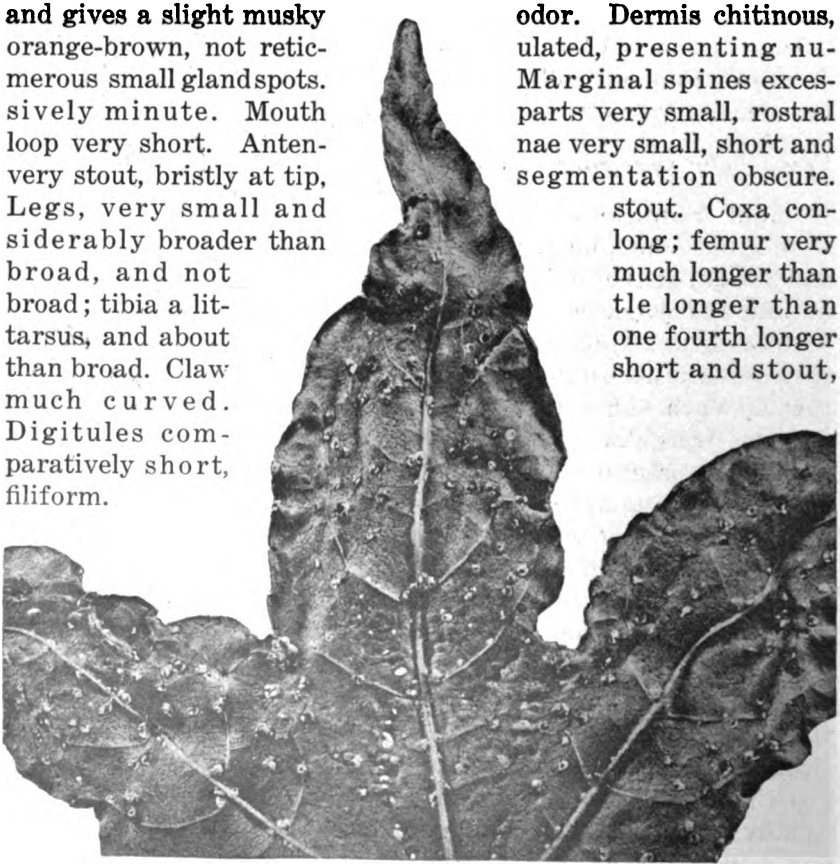

Fig. 65.—Sweet Gum Gall Scale, *Cryptophyllaspis liquidambaris* Kotinsky, on sweet gum. Enlarged twice. (Original.)

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"The embryonic larvae is remarkable for the large marginal spines, about 17 on each side."

Plants found infested in Florida: *Magnolia glauca; Magnolia grandiflora.*

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell's original description in Psyche Vol. VIII, p. 152 (1897).

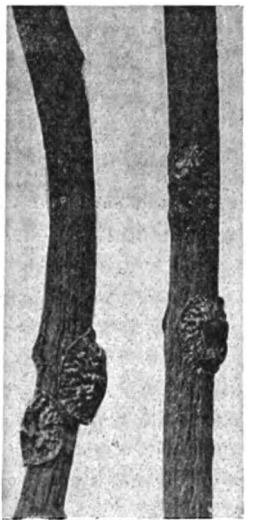

Fig. 66.—*Toumeyella turgida* (Ckll.), on *Magnolia grandiflora.* Slightly enlarged. (Original.)

West Indian or White Peach Scale
Aulacaspis pentagona (Targ.)
(Fig. 68)

Scale of Female.—The scale of the female is from 1 mm. to 2 mm. in diameter. It is usually circular, often ovate, thick and convex. The color is white or dark gray. The exuviae are bright orange-yellow or red in color and are situated between the center and the outer edge of the scale.

Scale of Male.—The scale of the male is similar in color to that of the female, but is elongated and narrow. It is usually white in color and often faintly tricarinate.

Plants found infested in Florida: chinaberry; holly; Japanese persimmon; locust; mulberry; okra *(Hibiscus esculentis);* peach; pepper; persimmon; plum; privet.

Other plants liable to become infested: *Acanthus;* apricot; *Argyreia speciosa;* bastard cedar *(Guaguma ulmifolia); Bryophillum calycinum; Callacarpa lanata; Calotropis procera; Carica papaya;* cherry; cherry laurel; cotton; *Cycas circinalis; Cycas media;* geranium; grape; heliotrope; *Jasmimum;* pear; pecan; *Pelargonium;* pepper *(Capsicum);* privet; prune; *Ricinus communis; Sedum; Tylophora asthmatica;* walnut; *Zamia mexicana; Zizyphus.*

Fig. 67.—White Oak Scale, *Lecanium quercifex* Fitch, on water oak. Enlarged twice. (Original.)

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White Oak Scale

Lecanium quercifex Fitch

(Fig. 67)

"Adult Female.—Shape elliptical, tapering slightly at both ends; dorsal cuticle dark brown, with small clear areas each of which contains a very small dot; length 4 mm.; width 3 mm.; antennae seven segmented, with the third and fourth subequal; anal plate slightly more than one half as broad as long, with the lateral margins subequal, and the lateral extremity and the apex rounded; with two subapical and four apical setae in each plate, with the latter clustered at the apex and the anterior seta one-ninth of the length of the plate from the apex; with four fringe setae, subequal in length, in groups of two; with short transverse rows of short striations on the hypopigium; all of the spiraclar setae long and conical, with the first of each group slightly over one-half as long as the middle one; most of the marginal setae short and blunt, with the longest less than one half as long as the first spiracular setae; oviparous."

Fig. 68.—West Indian or White Peach Scale, *Aulacaspis pentagona* (Targ.), on persimmon. Enlarged twice. (Original.)

Plants found infested in Florida: live oak; water oak *(Quercus nigra)*.

Other plants liable to become infested: white oak; willow oak.

Distribution in Florida: Gainesville; Marianna; Tampa.

Remarks: The above description is taken from Thro, Bulletin 209, Cornell University Exp. Sta., p. 213 (1903).

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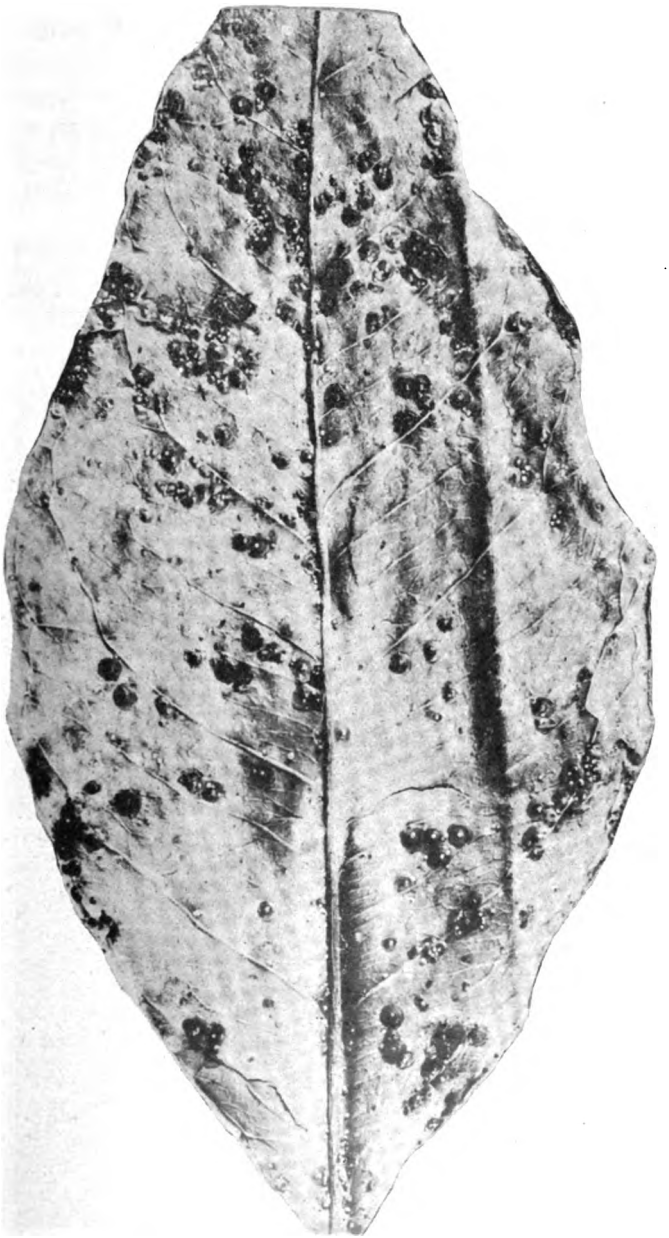

Fig. 69.—Yellow Scale, *Chrysomphalus citrinus* (Coquillett), on orange. Enlarged twice. From specimens collected by E. O. Essig, Chico, Cal. (Original.)

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Yellow Scale

Chrysomphalus citrinus (Coquillett)

(Fig. 69)

Scale of Female.—The scale of the female is circular with rough and irregular edges. It is very flat and yellow in color. The diameter is from 1/16 inch to 1/8 inch. This species is distinguished from the red scale of California *(Chrysomphalus aurantii* (Mask.)*)* by its color and feeding habits.

Plants found infested in Florida: citrus.

Other plants liable to become infested: *Aucuba;* Daphne; English ivy; Euonymus; *Ficus indica.*

Distribution in Florida: Cocoa.

Ziziphus Scale

Parlatoria ziziphus (Lucas)

Scale of Female.—The scale of the female is from 1.25 mm. to 2 mm. (1/25 inch to 1/12 inch) in length. It is black with a grayish or whitish posterior portion, and is circular or elongated in shape.

Scale of Male.—The scale of the male is white, brownish or yellow in color. It is elongate and about half the length of the female. The exuviae are black.

Plants found infested in Florida, none.

Plants liable to become infested: date palm; orange; *Ziziphus pinnachristi.*

Remarks: The specimens examined by the author were found on Italian lemon taken in market and on oranges from Spain, taken by Mr. E. L. Gehry at Key West, Fla.

Fig. 70.—Ziziphus Scale, *Parlatoria ziziphus* (Lucas), on orange. Enlarged twice. Specimens collected by Prof. H. H. Hume, in Spain. (Original.)

Unidentified Species

In gathering the material for this bulletin, two undescribed species have been received, (1) *Kermes* spp., collected by Mr. F. F. Bibby, Ft. Pierce, Fla., on water oak, and

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(2) *Orthesia* sp., collected by Mr. Geo. D. Sloan, Elfers, Fla., on Spanish moss. These species were sent to Mr. E. R. Sasscer, Chief Inspector of the Federal Horticultural Board, for identification, and reports on them have not been received in time to include in this bulletin.

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CONTROL OF SCALE-INSECTS, OR COCCIDAE, IN FLORIDA*

E. W. BERGER

For the purpose of control, insects injurious to plants may be divided into those that bite and chew their food (grasshoppers, beetles, caterpillars and others) and those that suck the liquids of plants by penetrating the surface by means of their sucking beaks (scale-insects, plant-bugs, plant-lice or aphids, and others). As just indicated, scale-insects belong to the group of sucking insects.

Scale-insects, on the other hand, are divided into two principal groups, the "Armored Scales," with a horny or dense wax-like covering or scale over their bodies, and those without such a covering, which the writer will designate as the "Unarmored Scales." The Armored scales include such common scales of citrus as purple scale, long scale, Flordia red scale, chaff scale, etc., and such scales as San Jose scale, white peach scale, palmetto scale and others, infesting many plants. The unarmored scales include the so-called soft scales and similar forms, the cushiony scales (including the cottony cushion-scale), mealy bugs and similar forms, and wax scales. While some of these, like the soft scales (soft brown scale, hemisphaerical scale, black scale, etc.) have no covering except the skin of the body others, like the cushiony scales, have cottony egg-sacs composed of wax-like material wholly or partly underneath the bodies of the mature insects. The mealy bugs generally have some powdery wax-like material or tufts of the same material on the bodies, sometimes completely covering them, and some of them deposit their eggs in small masses of such material isolated from their bodies. The wax scales have plates of wax covering the body.

Concomitant with the habits of insects that determine the two main classifications just indicated in the first paragraph, go two distinct methods of control. The biting insects may be poisoned by means of stomach poisons such as lead arsenate, Paris green, other arsenicals and poisons; sucking insects cannot be poisoned in this way but must be destroyed by liquids or dusts that kill by contact, such as oils, oil emulsions, soaps, sulphur compounds, tobacco extract, tobacco dust, pyrethrum or Persian insect powder, and others.

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*This paper is a companion paper to "Some Florida Scale-insects", by Mr. C. E. Wilson, published in this number of The Quarterly Bulletin.

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The standard remedies or sprays for scale-insects are oil emulsions, soaps, and lime-sulphur. The formulas recommended will be given at the end of this paper. In the following paragraphs control measures for the several groups of scales, as also for several individual scales, will be discussed in more or less detail.

Armored Scales

Of the Armored Scales, the control of the purple scale *(Lepidosaphes beckii)* and the long scale *(Lepidosaphes gloverii)* has probably been the most carefully worked out. While well defined broods of young scales, or "crawlers," are not generally recognized for these scales, nevertheless there are three periods during which crawlers are most abundant; March-April, June-July and September-October.

Since these crawlers are very easily killed, even by weak soap solutions, a good time to spray for these scales is when crawlers are abundant. Such periods can be better recognized, however, by frequent examination of the trees by means of a hand magnifier, during the months when the largest broods of crawlers are expected. This is important, because variations in the seasons produce variations in the time of the appearance of the crawlers. Whenever 2 or 3 crawlers per square inch of bark, leaf or fruit surface are visible, it is considered time to spray. The writer has, on the other hand, counted as many as 100 crawlers per square inch. Crawlers are minute and barely visible to the unaided eye as specks of whitish dust, but readily visible with a hand magnifier as minute insects frequently moving about. If the magnifier is an unusually good one, six legs and two antennae, so-called feelers or horns, may be seen on each crawler.

After a few hours of active life these crawlers permanently affix themselves to the tree by inserting their sucking beaks and beginning to feed. They assume a circular shape and soon secrete a bit of loose waxy material as a covering. In this condition they are known as "sets" and are still easily killed by even weak contact insecticides. After 18 to 20 days or, roughly, 3 weeks, the sets shed their skins and begin to form the permanent horny scale-covering, to which, however, the minute shed skin with its two horn-like projections remains attached, giving to young scales a rather characteristic appearance. Time for spraying is still good, but becomes less effective from now on as the permanent scale covering increases in size.

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The preceding account of the development of the crawler from the time of hatching, during its first 18 to 20 days or, roughly, 3 weeks, gives the basis for the recommendation that, in order to get the best results, spraying for scales should be repeated every 2 or 3 weeks, until 2, 3 or even 4 sprayings have been made. Spraying as thus recommended has the effect of killing off each hatching of young scales before they reach a stage where they are difficult to kill. Theoretically considered, 4 sprayings at intervals of 3 weeks should completely eradicate the long and purple scales from a tree, since 12 weeks, or 3 months, is the average length of life of a female scale. Having killed off the young that hatched during each 3 weeks, no more females will be allowed to mature, and by the end of 12 weeks the mature females, having completed their egg-laying period and died, the work may be regarded as completed. It is not likely, however, that in actual practice 4 sprayings will always be made, except in nurseries, where complete eradication may be sought. Neither will complete eradication always be effected, since it is not always possible, practically, to reach all parts of a tree with a spray, while, on the other hand, the life-history period may be lengthened so that live scales and eggs will remain after the last spraying.

Finally, while the ideal time to spray for scales is while they are abundant in the first 3 weeks of their lives as crawlers or sets, approximately during March-April, June-July, September-October, it may not always be advisable to wait for the appearance of crawlers, but to spray when the trees need relief, with the strongest spray usable at the time, and then, if necessary, spray again, a second or third, or even a fourth time, at intervals of 2 or 3 weeks. As a matter of fact, most growers will be satisfied with 1 or 2 sprayings, especially if they were timed at all so as to be effective, preferring to spray again during the next year, and probably depending during part of the year, the period of summer rains, on the fungus parasites of these scales.

The least opportune time to spray is when most of the scales are in the egg stage, since eggs are even less easily destroyed by sprays than the mature scales. As it is not always easy for the average grower to determine in what stage of development his scale-insects are in, it is advised that he send an abundance of specimens, leaves, twigs, or fruit, to this Department, the Experiment Station, or Federal entomologists stationed in Florida, for examination. Specimens for transportation should be

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made into small packages carefully wrapped several times with paper, then packed in a tin or wooden box, and again wrapped in paper before mailing or expressing. These precautions are necessary in order to avoid the danger of crawlers escaping in transit.

The use of fungus parasites of these and other scales should not be omitted during the period of summer rains. A more detailed account of these fungi will be found towards the latter half of this paper. These may be started in scale-infested trees by tying pieces of twigs or bark, or leaves, having some one or all of these fungi upon them, onto the worst infested twigs and branches. The pieces need only be 2 or 3 inches long by about ½ inch wide, and should be so tied that the rains may wash the spores, or "seeds," of these fungi down over some of the scales. Should a grower decide to introduce a whitefly fungus at the same time, material of a scale fungus may be rubbed in water with a brush or a wet cloth and sand and mixed into the mixture of the whitefly fungus and water, and the whole sprayed into the trees.

The control by spraying of all other armored scales is practically the same as that indicated for the purple and long scales, but as the life histories of but few of them have been worked out as carefully, our recommendations cannot be so specific. Spraying should be started preferably when crawlers and sets are abundant, and repeated when they again appear, as often as necessary. Oil emulsions, soaps and lime-sulphur are the sprays recommended.

The spraying of deciduous trees infested with scales becomes considerably simplified. These are generally sprayed in winter when the trees are free from foliage and when a spray sufficiently strong to destroy all stages of the scale may be employed. The spray generally employed for trees without foliage is lime-sulphur solution. For San Jose scale, this is applied with best results just as the buds of the trees begin to swell. The strength employed for trees without leaves is 1 part to 7, 8 or 9 of water, or as directed by the manufacturer. When it becomes necessary to spray deciduous trees in full foliage, the insecticides must be used in much greater dilution as indicated in the formulas.

Most, if not all, of the armored scales are more or less attacked by the several lady-beetles and one or two other predacious beetles known in Florida, or by a number of hymenopterous parasites; these latter are minute wasp-like insects.

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Scales of the following genera are Armored Scales: *Aspidiotus, Aulacaspis, Chionaspis, Chrysomphalus, Comstockiella, Conchaspis, Cryptophyllaspis, Diaspis, Hemichionaspis, Howardia, Ischnaspis, Lecaniodiaspis, Lepidosaphes, Leucaspis, Parlatoria, Pseudoparlatoria,* and others.

Unarmored Scales

Soft Scales and Others. As previously explained, these scales have no covering of any kind over the body and when fully developed are much larger than any of the armored scales. Scales of the genera *Asterolecanium, Coccus, Eucalymnatus, Lecaniodiaspis, Lecanium, Kermes, Neolecanium, Saissetia* and *Toumeyella* are regarded in this paper as belonging to the soft scales. They are generally easily destroyed by spraying with oil emulsions or mixtures of soap and water, using the strengths indicated in the formulae at the end of this paper. It may often be necessary to spray a second time, after 2 or 3 weeks, in order to destroy the young scales or crawlers concealed under the old scales at the time of the first spraying or that hatch from eggs so concealed.

All of the so-called soft scales found in Florida are probably regularly parasitized by minute wasp-like insects belonging to the Hymenoptera. Parasites of this kind are regularly observed on many specimens received and appear to be generally sufficient to keep them under control. Thus, *Coccophagus lecanii* Fitch is very common on the soft brown scale.

Several species have also been found infected with a fungus of the genus *Aschersonia* that greatly assists in keeping them under control. The fungus found on the soft brown scale and hemisphaerical scale may have been either the *A. turbinata* or *A. cubensis.* At the time the observations were made the fungus infecting these scales was supposed to be the *A. turbinata,* but it may have been the *A. cubensis.* This last named fungus has recently been observed at Gainesville almost completely eradicating a severe infestation of the liriodendron scale *(Toumeyella liriodendri* (Gmel.)*)* on banana shrub, and more recently at Oneco severely infecting the palm or tessellated scale.

Cushiony Scales. These scales are also large, and as stated in the first part of this paper, the mature insects have some cottony material wholly or partly underneath them in which the eggs are deposited. This fact makes them more difficult to

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control, as insecticides do not always readily penetrate the cottony masses, or egg-sacs. The green shield scale, the pyriform scale, cottony maple scale, the rose palaeococcus and the cottony cushion-scale are listed under this topic for the purposes of this paper.

Oil emulsions and mixtures of soap are recommended as sprays for these scales, but as already indicated, the eggs being so well protected by the cottony material, it will always be necessary to repeat the spraying after two or three weeks and frequently again after another 2 or 3 weeks. Extra amounts of soap should be mixed with the oil sprays, and if soap alone is used it should be used strong, 15 to 18 lbs. per 50 gallons of water. Soap penetrates the cottony material better and also has the effect of sealing the eggs and young in it. The writer has in mind one grower who several years ago very successfully used the following mixture against cottony cushion-scale: 15 lbs. fish-oil soap, 3 quarts soda-sulphur and 1 gill thripjuice to 50 gallons of water.

Fortunately, most of these scales are heavily infested with other insect parasites and predacious insects so that spraying solutions are rarely needed. Thus the cottony cushion-scale is almost perfectly controlled by the Vedalia, or Australian Lady Beetle *(Novius cardinalis)*, which the Entomological Department of the Plant Board has been furnishing to growers during the past two years. The scale-eating caterpillars of two species of moths *(Laetilia coccidivora* and *Pyrodirus rileyi)* are regularly found feeding on the cottony cushion-scale. A small fly *(Cryptochaetum monophlebi* Skuse*)* introduced into California from Australia and found to be an effective parasite of cottony cushion-scale in that state, was received from the California Insectary, through the courtesy of Harry S. Smith, Supt., in March, 1917. Specimens of this fly were colonized at Stanton and near Winter Haven, Florida, but whether it has succeeded in establishing itself has not yet been determined.

The green shield scale is also regularly found abundantly preyed upon by the two caterpillars named in the previous paragraph. Besides these two caterpillars, a small black fly, *Leucopis nigricornis* Egger, has been abundantly reared from masses of this scale, of which it appears to be an effective parasite or predator.

MEALY-BUGS AND SIMILAR FORMS. Insects of this kind either have powdery wax-like material, or tufts of the same material

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wholly or partly covering their bodies. The eggs of some forms are also deposited in cottony material, thus frequently making it difficult to destroy the eggs and newly hatched larvae, or crawlers. Insects of the genera *Dactylopius, Orthezia, Pseudococcus,* and similar ones are included here.

Oil sprays and soap mixtures, preferably with tobacco extract, are recommended for these insects. But like with the soft scales and cushiony scales, spraying should be repeated in 2 or 3 weeks in order to destroy the young hatched from the eggs protected by the cottony material at the time of the first spraying. It is also considered important here to use extra quantities of soap in the oil sprays and to apply the spray with all the force possible, preferably with a nozzle that throws a strong central stream. This applies especially to the mealy-bugs proper, in order that the spray may be forced into the cottony material and the eggs and insects dislodged.

In California, a kerosene-lime mixture (see end of this paper) has been found most efficient as a spray against mealy-bugs.

Water, when it can be applied as a spray sufficiently strong to dislodge the mealy-bugs and the cottony masses containing the eggs, is a very good remedy.

Mealy-bugs do not often become a pest in Florida and the presumption is that other insects or fungus diseases keep them in check but, for some reason or other, the facts in the case have not been sufficiently investigated. Recently, Prof. Watson, of the Experiment Station, has received colonies of the Sicilian mealy-bug parasite, *Parleptomastix abnormis,* from California, which he has colonized in different parts of Florida.

WAX SCALES. The largest of these scales, the Japanese wax scale, is about ¼ inch in diameter. Two others, the Florida wax scale and the barnacle scale, also found in Florida, are not so large. They are covered with wax, generally arranged in plates, and rather soft as compared with the horny wax-like material covering the armored scale insects.

The writer is not aware that spraying on account of these insects has ever been carried on, and is probably rarely necessary. When necessary to spray, 3 or 4 sprayings at intervals of two or three weeks, with oil emulsions or mixtures of soap and water will probably be needed. It is the writer's belief that, due to the covering of wax, only the crawlers and immature scales with incomplete coverings of wax can be killed by spraying, which fact will necessitate successive sprayings until

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the old scales have died and no more eggs and young are produced.

Exit holes of internal parasites have occasionally been observed on these scales, indicating at least some degree of control by these insects.

Of fungus parasites, the turbinate aschersonia *(Aschersonia turbinata)* has been repeatedly observed by the writer as a most effective destroyer of the Florida wax scale.

Fungus Parasites of Scale-insects

Florida is peculiarly fortunate in having a number of fungi that generally very effectively control the scale-insects which they attack. There are six principal fungi that infect scale-insects, besides five others that destroy only whiteflies.

At present none of the scale fungi are being grown in artificial cultures like the Red Aschersonia, one of the principal parasites of whiteflies, so that growers must still depend upon getting supplies of such fungus material from trees and groves in which it occurs. When getting such supplies of fungus material growers must be on the lookout so that they do not get material from diseased groves and in that way introduce a new disease. As a rule, it will be best to first consult with inspectors of the Plant Board, or directly with the Plant Commissioner, as to whether it is safe to get fungus from any certain groves or localities.

The scale fungi are generally introduced into scale-infested trees by tying pieces of twigs, bark or other material, having fungus upon it, onto the limbs where the scales are most abundant in such a manner that rains will wash the fungus spores down over masses of scales. The pieces of fungus material employed need not be larger than 2 or 3 inches long by ½ inch wide. The amount of fungus used may be regulated by the amount available, but the more the better. The period of summer rains is the proper time in which to introduce fungus.

The scale fungi may also be introduced by thoroly rubbing up fungus material in water in such a manner as to liberate the spores and then spray the mixture of spores and water into the scale-infested trees. Fungus material may be rubbed fine and the spores liberated either by brushing it in water with a stiff scrubbing brush or rubbing it with a wet cloth and some sand. In case a whitefly fungus is also being introduced, the scale fungus material in water may be added to the spores and water mixture of the whitefly fungus, and the whole sprayed into the

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trees at one time. Such mixtures of fungus and water must, of course, first be strained thru fine wire gauze or coarse cheesecloth in order to strain out all coarse material liable to clog the nozzles.

No grower can make a mistake by introducing any or all of the scale fungi, provided, of course, he has the scales on which they thrive; and thruout a series of years they will undoubtedly save many spraying bills.

RED-HEADED SCALE FUNGUS. This fungus *(Sphaerostilbe coccophila* Tul*)* has been known as an effective parasite of certain scale-insects in Florida and other Gulf States for many years, and occurs in several other parts of the world. As the name indicates, the fungus develops small brick-red heads from the sides of the infested scales. These heads are approximately ¼ the size of a pinhead, spindle-shaped, and consist of a bunch of spores, or "seeds," of the fungus.

This fungus has been found destroying the following scales: purple scale, long scale, San Jose scale, oleander or chinaberry scale, chaff scale, red maple scale, California red scale, and the latania scale. This is not a complete list, but includes only those scales on which it is commonly found.

WHITE-HEADED SCALE FUNGUS. This fungus *(Ophionectra coccicola,* E. & E.*)* is undoubtedly equal, if not superior, in efficiency to the red-headed scale fungus as a destroyer of the long, purple and chaff scales of citrus. It has about the same distribution as the latter and was observed in Florida as long ago as 1885 by the late H. G. Hubbard, of the Bureau of Entomology, U. S. D. A. Mr. Hubbard, however, supposed that it was a scavenger fungus, living on dead scales, instead of a parasite that actually destroyed live scales. There are grounds for believing that it was this fungus that saved the day for the citrus growers when in the 40's of the last century the long scale, then recently introduced, threatened the destruction of the orange groves about Mandarin and St. Augustine. All kinds of remedies had been tried, including whisky and aloes, but to no avail, but later the trees began to recover, which must have been due to the spread of parasites, fungus or insect, or both. The grounds for believing that the white-headed scale fungus was present then is the fact that Mr. Hubbard found it in the St. Johns River section, and because it appears to be the oldest on record (1885) in Florida.

In appearance it is quite like the red-headed scale fungus,

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but the heads and other growth are grayish-white instead of brick-red.

The following scales are destroyed by this fungus: the long scale, purple scale, and probably also the chaff scale.

THE BLACK SCALE FUNGUS. The black scale fungus *(Myriangium duriaei* Mont.*)* is another useful scale destroyer widely distributed in Florida. Its appearance on the trees, principally the bark, is like black spatter from a paint brush wet with black paint.

It occurs on the chaff scale, the purple scale, the long scale, the San Jose scale, and probably the snow scale of citrus.

THE PINK SCALE FUNGUS. This fungus is apparently a more recent arrival in Florida. At all events, it was not recognized as a separate species until December, 1912, when Professor P. H. Rolfs, Director of the Expt. Station, recognized it as different from the red-headed scale fungus, for which it had apparently been previously mistaken. It now occurs widely distributed in Florida and also in Japan where it was described by Miyabe and Sawada as *Microcera fujikuroi.* In appearance it is quite like the red-headed scale fungus but spreads out more about the edge of the scales thus forming a small red area about them. Its pink color is due to the presence of light colored hairs on the heads which obscure the deeper red underneath. These hairs are absent or scanty on the red-headed scale fungus.

It is particularly a parasite of the Florida red scale, but will also infect the purple scale. According to Prof. J. R. Watson, Fla. Expt. Sta. Report for 1914, it is far more effective on this scale than the red-headed scale fungus is on the purple scale. It has also been received on the California red scale in Florida, and the obscure scale of oak.

THE TURBINATE FUNGUS. *Aschersonia turbinata* is quite different in appearance from the other scale fungi. The visible portions consist of a short thick whitish stalk, approximately ⅛ inch long, sometimes branched, with a depression at the top. The inside of this depression is bright red when fresh, but faded when old.

This fungus is a common parasite of the Florida wax scale. It probably also infects others of the so-called soft scales, but there is some confusion in regard to this just now, as the Cuban Aschersonia (see next topic) has undoubtedly been mistaken for it.

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THE CUBAN ASCHERSONIA. *Aschersonia cubensis* is probably more or less widely distributed in Florida, but was only recently (March, 1917) distinguished from *A. turbinata.* The identification was made by Dr. Thaxter, courtesy of A. T. Speare of the Bureau of Entomology, U. S. D. A. This fungus is not unlike the turbinate fungus, but, instead of a single or branched whitish stalk, it consists of a low dome about the size of, or larger than, the insect that it infects. Over the top and sides of this dome are a number of small cavities filled with the reddish or yellowish spores of the fungus.

It has so far been positively identified infecting the liriodendron scale and the palm, or tessellated scale, but it is believed that one or two others of the so-called soft scales may be hosts.

SOME CONTACT INSECTICIDES EMPLOYED AGAINST SCALE INSECTS.

YOTHERS' FORMULAS. These formulas were devised by Mr. W. W. Yothers, Field Agent of the Bureau of Entomology, U. S. Dept. of Agriculture, stationed at Orlando, Fla., and were intended primarily for spraying the whitefly, but they are also excellent for spraying all kinds of scale-insects. The formulas are simple and no heat is necessary, except for the last one, in order to get the ingredients to combine.

Mix 2 gallons soft fish-oil soap and 1 gallon water.

To this mixture of soap and water, slowly add 3 gallons Diamond Paraffine, Junior Red Engine or other lubricating oil, 24 to 28 degrees Baume, at the same time stirring the mixture vigorously, or pumping it back into itself several times until all the oil is emulsified.

The product is the stock solution which has a thick cream-like consistency. For spraying citrus trees, dilute stock solution at the rate of one gallon to 50, 60, 70, 80, 90, or even 100 gallons of water. For spraying during May, through summer and early fall, use the mixtures, 1 in 70, 80, 90, or 100. For late fall, winter, and early spring, the stronger mixtures, 1 in 50 or 60. For spraying dormant deciduous trees without foliage, the mixture may be used as strong as 1 in 10. On deciduous trees in foliage, and other tender plants the mixture should be used very weak, and even then it is best to first experiment on a few plants.

Mr. Yothers also devised the following formula, which contains less soap and is cheaper, but requires more stirring to prepare the stock solution.

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Fish-oil soap, 1 gallon.
Water, 1 gallon.
Oil as previously indicated, 2 gallons.

Prepare and dilute for spraying as indicated in the first formula.

Yothers' "New Formula" contains still less soap, but requires heat in its preparation. The proportions of the ingredients are as follows:

Fish-oil soap, or laundry soap, 2 lbs.
Water to make 4 gallons of stock solution, about 1¾ gals.
Oil as in the other Yothers' formulas, 2 gals.

This mixture must be heated to the boiling point, preferably over an open fire in order to avoid accidents of fire to buildings, and then agitated as directed in the first formula. for spraying, it is diluted as directed for the first formula.

Any other kind of soap can probably be substituted for the fish-oil soap in all of these formulas, but hard soap must first be dissolved in hot water.

If the water to be used for diluting the stock solution is hard, so that free oil rises to the surface when some of the stock solution is added to it, it will be necessary to first soften it by adding soap until it begins to lather and feel decidedly slick to the hands.

Lye, washing soda and borax are sometimes recommended for softening water, but are not always reliable because they do not neutralize all water-hardening minerals.

PROPRIETARY MISCIBLE OILS AND EMULSIONS. There are several of these on the market that give excellent results, but like the Yothers' formulas, if hard water causes free oil to rise to the surface, this must first be softened by the addition of soap. One to four pounds of soap to 50 gallons of water will generally be found sufficient.

SOAPS. Soap solutions are very good insecticides. While fish-oil or whale-oil soap is generally recommended and used, any other soap may be just as good. The writer has used laundry soap successfully. When there are only a few trees or plants to be sprayed, a few bars of laundry soap, always available, may be used. One pound of soap to five or six gallons of water will be found strong enough during periods of warm weather,—in May, through the summer, and early fall. For spraying scales and whiteflies during the late fall, winter and early spring, or during the cooler parts of the year, one pound of soap to three or four gallons of water may be used. There

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is very little danger that one pound in five or six gallons of water will cause any injury to fruit or foliage, but the stronger solution, one pound to three or four gallons of water, may cause some injury when applied to trees with fruit and tender foliage. One pound of soap to 10-15 gallons water is sufficient for such soft-bodied insects as plant lice and flower thrips, especially if some tobacco extract is added.

KEROSENE EMULSION. This is an old standard remedy long employed against many kinds of sucking insects. It is convenient to make because the necessary ingredients are generally at hand, but may injure foliage if carelessly made and applied. In recent years it has been largely superseded by Yothers' formulas and commercial oil sprays. Dissolve ½ lb. soap (a little more if soft soap) in a gallon of hot water. Bring the mixture of soap and water to boiling and then, away from the fire, add 2 gallons of kerosene and begin to stir vigorously at once. Continue to stir until a smooth creamy mass, that will not separate, is the product. If a bucket pump is at hand the mixture may be pumped several times back into itself instead of stirring. This mixing process may require 5 to 15 minutes. For use on dormant trees and shrubs dilute the emulsion with 5 to 7 parts of water; for use on growing plants with 10 to 15 parts of water. Kerosene emulsion is much safer if applied on bright breezy days, not scorching hot, as that facilitates evaporation. The weakest solution is strong enough for plant-lice, and other soft-bodied insects; the strongest on dormant trees for scale-insects.

KEROSENE-LIME MIXTURE. This mixture is highly recommended in Bul. No. 258, Calif, Expt. Station, as a spray against mealy-bugs, and is here reproduced verbatim from that bulletin.

"Kerosene (42 degrees Baume), 20 gals.
Unslaked lime, 40 lbs.
Water, 200 gals.

"In preparing the mixture the lime is gradually slaked in a barrel or other convenient receptacle and thoroughly mixed to a creamy consistency. For convenience in handling, a mixture of one pound of lime per gallon of water should be used. The necessary quantity of this material should then be strained and placed in the tank, the kerosene and sufficient water to cover the agitators added, and the engine started. Three or four minutes will be sufficient to bring about a thorough emulsification. In case the mixture is permitted to stand for some time,

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the lime and kerosene which it has absorbed will sink to the bottom of the tank and a thin layer of frothy lime will appear on the surface. The emulsion, however, is stable and requires only agitation to be ready for use.

"The use of lime as the emulsifying agent instead of soap was found to increase considerably the penetration of the waxy covering of the mealy bugs. Where large egg masses are found upon the fruit and twigs, the penetration will not be complete by the first application, but a thin crust of lime will be formed over the surface, which will prevent the exit of the young mealy-bugs from the navels of the oranges. The white coating of lime deposited over the entire tree brought out strongly the fact that in field spraying as ordinarily practiced the uppermost branches in the center of the tree were very often left unsprayed, and as a result the possibilities of a rapid reinfestation were very good. The presence of some indicator in the spray is particularly desirable in mealy bug control work, where application to every portion of the tree is a prime necessity."

LIME-SULPHUR SOLUTION. Proprietary, or boiled lime-sulphur, when diluted 1 to 40-75 with water will destroy young scales, but its use in such weak dilution for this purpose alone is not advised. Lime-sulphur, in weak dilution, is the standard remedy for mites, and whenever it is necessary to spray for these, and it is also possible to time the spraying to catch a brood of young scales, this should be done.

It is not considered good practice now to undertake the boiling of lime-sulphur at home unless large quantities are needed, hence directions for boiling it are not included in this paper.

Diluted 1 part to 7, 8 or 9 of water, it is the standard remedy for San José scale on peach and other deciduous trees in the dormant leafless, or winter condition. It may also be used against other scales on dormant deciduous trees.

The proportions just indicated for the application of boiled, or proprietary, lime-sulphur are assumed to be based on stock solutions having a Baume test of 32 degrees. (It will suffice here to explain that "*degrees Baume*" refers to readings on the Baume hydrometer, a glass instrument used for testing the density of liquids.) But as different brands of lime-sulphur and home-made solutions may have quite a wide range of density, the following table is included, from which the proper amount of water to be added to any stock solution, or concentrate, testing otherwise than 32 degrees, may be ascertained.

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Thus, if the stock solution tested 30 degrees Baume, and a spray solution of 1-75, based on a stock solution of 32 degrees Baume is desired, the middle figure, 69, in the next to the last column gives the number of parts of water to be added. In order to be accurate, on the one hand, and on the other hand to know that proper value is being received for his money, a grower should obtain from the dealer or manufacturer the degrees Baume, or density, of the product bought, or should obtain a Baume hydrometer and make his own tests.

(The table here given is copied from Bulletin 289, Agric. Expt. Station of Cornell University.)

"Table 8.—Showing the Corresponding Number of Dilutions of Lime-Sulfur Solution of Various Densities Using 32 degrees Baume as a Standard.

Degrees Baume	Specific gravity	1-10	1-15	1-20	1-25	1-30	1-40	1-50	1-60	1-75	1-100
25	1.208	7.4	11.0	14.7	18.4	22.1	29.5	36.8	44.2	55.0	73.0
26	1.218	7.7	11.6	15.4	19.3	23.2	30.9	38.6	46.3	58.0	77.2
27	1.229	8.1	12.1	16.1	20.2	24.3	32.4	40.5	48.5	60.6	80.7
28	1.239	8.4	12.7	16.9	21.1	25.4	33.8	42.3	50.7	63.5	84.5
29	1.250	8.8	13.2	17.6	22.1	26.5	35.3	44.2	53.0	66.3	88.2
30	1.261	9.2	13.9	18.4	23.0	27.6	36.9	46.1	55.3	69.0	92.0
31	1.272	9.6	14.4	19.3	24.0	28.8	38.4	48.0	58.0	72.0	96.0
32	1.283	10.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	75.0	100.0
33	1.295	10.4	15.6	20.8	26.0	31.2	41.5	52.0	62.4	78.0	104.0
34	1.306	10.8	16.2	21.6	26.8	32.4	43.2	54.0	64.7	80.8	108.0
35	1.318	11.2	16.8	22.4	28.0	33.4	44.9	56.0	67.4	84.2	112.0

"Note.—The figures in the columns indicate the number of times the concentrate of a given density is to be diluted to give a dilution equivalent to that at top of column."

TOBACCO EXTRACT. While tobacco extracts are used mainly against such soft-bodied insects as aphids and thrips, they have also been found useful against mealy-bugs, especially in greenhouses. There are several commercial extracts available, including a 40% nicotine sulphate solution. Directions for application are given on each package, but 2 to 6 lbs. of soap should always be added to each 100 gallons of spraying solution. Much more soap may be used when it is deemed desirable or necessary to do so, or the prescribed amounts of tobacco extract may be added to the soap and water mixtures recommended under Soaps.

A home-made tobacco decoction useful against soft-bodied insects on many plants can be made by boiling a pound of tobacco, tobacco dust, leaves or stems, in two or three gallons

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of water until a dark-brown liquid is obtained. The decanted liquid may be used alone, or diluted to make double the quantity and soap added at the rate of 1 oz. per gallon. The soap makes it adhere better and spread more evenly, and besides, soap is a good insecticide by itself.

SWEET POTATO ROOT WEEVIL

WILMON NEWELL

For a number of years the sweet potato crop in certain sections of the South has been severely injured and, in many cases, totally destroyed by an insect known as the sweet potato root-weevil *(Cylas formicarius* Fab.*)*. In Louisiana the pest has been known since 1877 and considerable areas in southern Louisiana and southern Texas have become infested with the result that in many localities the growing of sweet potatoes on a commercial scale has been abandoned. The insect has also appeared at other points in the Gulf States, including a number of counties in Florida. The manner of introduction into Florida is not definitely known but from the fact that Cuban sweet potato tubers and plants infested with the weevil have frequently been intercepted by the Plant Board inspectors at Tampa and Key West, there is no doubt but what shipments of infested material from Cuba have been to a large extent responsible for the insect becoming established in this State. The lower East Coast in particular, because of steady commercial intercourse with Cuba, doubtless received its first weevils in shipments of sweet potatoes from the West Indies.

The 1915-'16 sweet potato crop of Florida amounted to 3,859,107 bushels, valued at $2,426,397.00*. Any insect capable of making serious inroads on this crop can, therefore, if it becomes generally distributed over the State, easily cause a direct loss to the farmers of a million dollars annually. Indeed, the acreage during the present season is unquestionably much greater than in previous years and it is a safe prediction that the Florida sweet potato crop of 1917-18 will exceed $3,000,000 in value. As will be shown below, the very existence of the sweet potato as a commercial crop in Florida will ultimately be threatened by the weevil unless energetic steps are taken to suppress it.

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History

The insect was first described by Fabricius in 1798. According to Conradi*, "the insect was not regarded as a sweet potato enemy until 1857 when Nietner recorded it as attacking sweet potatoes in the Island of Ceylon in 1856. Among the earlier entomological writers, Fabricius refers to it from India and Tranquibar, Boheman from the East Indies and Java, and Dejean from the Isle of France."

According to Comstock†, Le Conte reported it from India and Madagascar, as well as Cuba and Louisiana. Its occurrence in Guam was reported in the Experiment Station Record, Vol. XXVIII, No. 2 (1915).

The Federal Horticultural Board gives the following additional countries as being ones in which this weevil occurs: Haiti, Jamaica, British Guiana, China, Friendly Islands, Sumatra, Formosa, Philippine Islands, Australia and Liberia.

According to Chittenden*, the native habitat of the insect is credited to Cochin China, and he is certain that it is at least of Oriental origin. Opinions differ as to whether the insect was first introduced into Cuba or into Louisiana. In a recent conversation with the writer, Doctor Chittenden expressed the opinion that New Orleans was the first point of introduction and that from Louisiana the pest had spread to the West Indies as well as to other Gulf States, and that the infestation in southeastern Florida had probably come from Cuba. The insect was first noticed in the United States near New Orleans in 1877, at which time it was claimed that it threatened the destruction of the sweet potato crop, which prediction later on was fully verified.

The earliest record of the insect's occurrence in Florida seems to be that contained in the Report of Prof. J. H. Comstock, Entomologist, in the Report of the (U. S.) Commissioner of Agriculture for 1879, in which Prof. Comstock gives an account of receiving specimens of the "sweet potato borer" from Mr. J. W. Curry, of Manatee, Fla., on July 8, 1878, with the statement that "it seems to threaten the destruction of the sweet potato crop in this county". Prof. Comstock continues: "Mr. Curry was unable to give details respecting the habits of the insect, as he received the specimens from a planter residing

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* Bulletin No. 93, Texas Experiment Station.
† Report of the Entomologist; Report U. S. Commissioner of Agriculture, 1879, p. 249.
* "Insects Injurious to Vegetables", p. 235, 1912.

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some distance from Manatee. February 20, 1880, I visited the locality in question hoping to be able to make a thorough study of the pest. But I found that Mr. Gillett, the planter referred to above, had dug his sweet potatoes a few days previous on account of the ravages of this insect. I was informed that the injury caused by this beetle was very great. In some fields nearly the whole crop was said to be destroyed."

Although the Plant Commissioner and his assistants were aware of the published account, quoted in part above, regarding the weevil having been found in Manatee County as early as 1878, it was impossible, on account of all energies being directed to the immediate subjugation of citrus canker, to make any investigations regarding the sweet potato root weevil until the summer and fall of 1916.

In January, 1917, Mr. Arthur C. Mason, then Assistant Entomologist of the Plant Board, was sent to Manatee County to see if the pest still occurred there. Fortunately, he found that Mr. Curry was still living and, being favored with an interview with him, learned that Mr. Curry was postmaster at Manatee in 1879 and sent the first specimens of the insect to the Department at Washington; also that in 1878 the weevils ruined his entire crop. He also located for Mr. Mason the farm formerly owned by Mr. Daniel Gillett, on which the potatoes were severely infested with the weevil in 1878-'79. This farm, located 8 miles north of Palmetto, is at present owned by Mr. Frank C. Armstrong. Mr. Armstrong clearly recalled the damage done by the pest and also described the appearance of the insect in large numbers "10 or 12 years ago". According to Mr. Armstrong, in both instances a few of the insects were noticed the first year and then the following year they were thick and ruined the crop. The third year no one tried to raise potatoes and "after that they disappeared". Mr. Lee Armstrong, residing in the same neighborhood, also remembered the "potato bugs" well, stating that they were present for several years prior to 1895, and were worst in 1893 and 1894 just before the big freeze, but that after the freeze they disappeared.

Inspection was made by Mr. Mason of a considerable number of fields in the community and, strangely enough, no traces of the weevil were found.

It seems very difficult to account for the apparent disappearance of the pest in the vicinity of Manatee. No such incident has, so far as known, ever occurred in southern Louisiana

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and Texas where the pest has occurred for many years and no natural enemies of the weevil are known which are of consequence in reducing its numbers. Opinion of the planters in the Manatee section seemed to be divided as to whether the weevils were killed by the "big freeze" or whether they were exterminated by all farmers ceasing the cultivation of sweet potatoes entirely whenever the pest became so abundant as to destroy the crop. Towards the latter opinion Mr. Mason also inclined. If this is the real explanation it indeed points toward the thorough practicability and comparative ease of eradicating the pest from any given area, a point which is discussed on a subsequent page.

The first report of the appearance of the pest in Texas was in 1890. Since the latter date, reports of serious damage to sweet potato crops in the infested sections have been frequent. The insect has not been thoroughly studied by entomologists. Perhaps the most complete publication regarding it is Bulletin No. 93 of the Texas Experiment Station by Prof. Albert F. Conradi, formerly State Entomologist of Texas. Professor Conradi determined accurately the life history and the essential facts regarding the habits of the insect under Texas conditions. There remains, however, much information to be desired as to the habits of the insect under varying climatic conditions and during different seasons of the year.

Distribution in Florida

The sweet potato root-weevil has been known in Dade County for several years and sweet potatoes are not grown to any considerable extent in that county, although occasional patches are planted in gardens in an attempt to secure a few potatoes for table use.

Inspectors of the State Plant Board during the past year have found infestations by the weevil in the vicinity of Miami, Homestead and numerous other points in Dade County, at many places in Palm Beach County, including West Palm Beach, Lake Worth, Lantana, Hypoluxo, Boynton, Delray and Munyon's Island, at Ft. Lauderdale and Colahatchee in Broward County, Ft. Pierce in St. Lucie County and at City Point in Brevard County. It seems quite evident, therefore, that the entire East Coast strip of territory from City Point to Florida

* Fourteenth Biennial Report, Fla. Dept. of Agr., p. 257.

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City is more or less generally infested by the pest.* It is significant that the sweet potato crop throughout this entire area is very small, it being the exception that shipments of sweet potatoes are made from this territory to other points.

About Dec. 1, 1916, Prof. J. R. Watson, of the Florida Experiment Station, received specimens of the weevil from Mr. Wm. Dopson of Sanderson, Baker County. Investigations by Inspector K. E. Bragdon in Baker County in June, 1917, revealed the presence of the weevil at Sanderson, Glen Saint Mary and Macclenny. Apparently the starting point of this outbreak was near Sanderson, for at this point farmers were found who stated that they had noticed the insect for the first time three seasons before. On the farms where the insects had been noticed for three seasons, Mr. Bragdon found that the crop of 1916 was so badly damaged as to cause the farmers to discard from 30 to 50 per cent of the crop at the time of digging, and potatoes from the 1916 crop which were placed in storage were entirely ruined by the weevil before the spring of 1917, despite the care used to discard all potatoes seen to be infested at the time of digging.

Mr. A. L. Chandler of Homestead reports the occurrence of the insect at Cape Sable.

Investigations recently made by Mr. Bragdon show the presence of the insect in large numbers on Sanibel Island, Captiva Island and Buck Key in Lee County, although inspections have thus far failed to reveal the presence of the pest on the mainland in Lee County.

On August 30, 1917, Inspector H. B. Barnett discovered the weevil in one potato field near Citrus Park, Hillsborough County. Steps were at once taken in cooperation with the owner to eradicate this infestation. The work, which was carried out under the direction of Inspector E. R. Potter, is believed to have been successful, hence the writer does not feel that Hillsborough County, for the present at least, should be regarded as having infested territory within its borders.

DESCRIPTION

The adult insect is a weevil or "snout beetle", elongated in shape, smooth and glossy. The head is black, the thorax (middle section of the body) and legs are bright brick red, and the abdomen (posterior half of the body) is a beautiful dark steel-

*Since the above was written Inspector Walter O. Lahrman has found infested areas at Daytona, Volusia County.

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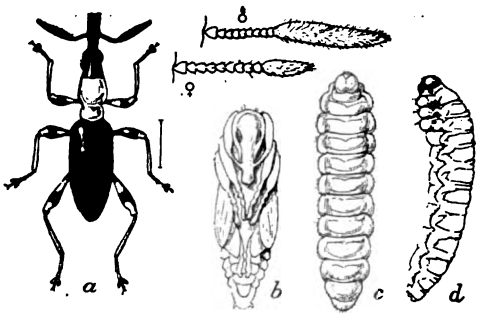

Fig. 71.—The Sweet Potato Root Weevil, *Cylas formicarius* Fab.: *a*, male beetle; ♂, antenna of male, enlarged; ♀, antenna of female, enlarged; *b*, pupa; *c*, larva, dorsal view; *d*, larva, side view—all enlarged. (After Chittenden, U. S. Dept. of Agriculture.)

blue. The adult is about one-fourth of an inch long and at first appearance is often mistaken for a large ant as it is ant-like in shape. The adults have only rarely been observed to fly although they possess fully developed wings, a fact established by both Prof. A. F. Conradi and Dr. E. W. Berger. Prof. Richard T. Cotton observed the beetles in flight at night in Porto Rico*. The weevils are able to walk and run about, but as a rule they do not run so rapidly that one cannot catch they readily with the hands.

Prof. Patricio Cardin, of Santiago de las Vegas, Cuba, has told the writer of finding one of these weevils flying around a light at the Experiment Station there.

The eggs are very small, yellowish white in color, and from one-fortieth to one-fiftieth of an inch in diameter. They are laid in cavities made by the female insect either in the vines or the tubers. When in the vines they are usually laid in the lower portions.

From the egg there hatches a minute, white, footless grub having a pale brown head. If in the stem when hatched, these grubs begin to feed and tunnel, usually towards the tuber. When tunneling in this direction, the tuber is eventually reached. Mr. Bragdon has noted cases, however, in which the grub was evidently proceeding in the opposite direction, and has found both larvae and pupae in infested plants in such a position as to indicate that it was not necessary for them to reach the tuber at all in order to complete their development. Conradi, on young plants without tubers, observed them develop successfully in the stem, "eventually killing the plant." If the eggs have been laid in or on the tuber itself, the grubs tunnel directly into the tuber and within a short time riddle it with numerous tunnels and galleries which soon become filled with excrement and decaying matter. The full-grown grub is

*Journal of Economic Entomology, Vol. 9, p. 516 (1916.)

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from one-fifth to one-half inch in length. Upon completing its growth the grub or larvae changes into the pupal or transformation stage (which corresponds to the cocoon stage of a butterfly). In this stage the insect is not active and does not feed, and indications of legs, antennae and wings make their appearance.

Life History

Professor Conradi made careful studies of the developmental stages under Texas conditions and found the following:

The egg hatches in from 5 to 6 days after being deposited. Approximately 15 days are required for the larvae to complete its growth, and the pupal stage lasts about 8 days, making a total of 28 to 29 days for the complete development of the insect

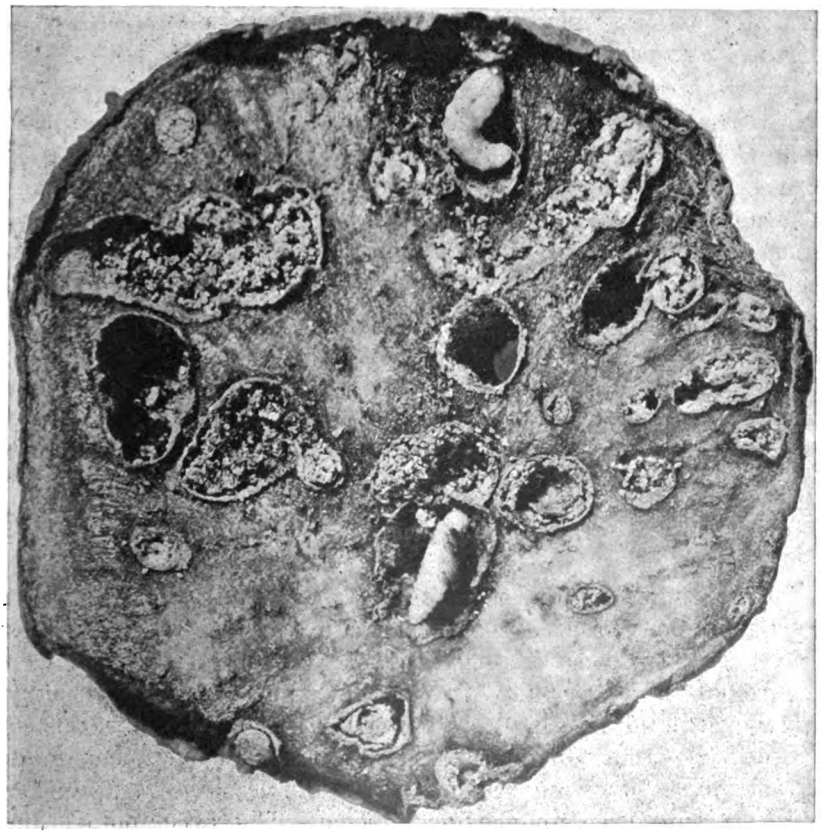

Fig. 72.—Cross-section of sweet potato tuber, infested with the sweet potato root weevil, showing how the interior is tunneled out and destroyed. A larva of the weevil can be seen in one of the galleries near the top and a pupa towards the bottom. (From a photograph furnished by Dr. F. H. Chitenden, Bureau of Entomology, U. S. D. A.).

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from egg to adult. Making allowance for a brief period between the maturing of adults and the laying of the first eggs, it is seen that a generation is produced about once every 35 days. Mr. Conradi states that during the winter season the time required for development, from egg to adult, on account of lower temperature, is increased by about fifteen days' time.

Assuming that a generation is produced in an average time of thirty-five days, there are at least eight broods during the course of the year. In Florida the temperature during most of the winter is high enough to permit of the uninterrupted development of the insect and breeding continues steadily in stored potatoes or in potatoes left in the field during the winter months. It would be safe indeed to estimate that fully seven to eight broods are produced in northern Florida during the year and ten or eleven broods in the extreme southern portion of the Peninsula.

As the period during which the female deposits eggs continues anywhere from two to twenty-one days, it naturally follows that there are no distinct generations but weevils in all stages from egg to adult may be found at almost any time. The rapidity of development, coupled with a mild climate which permits uninterrupted development throughout the year, explains why the pest is so destructive under Florida conditions.

Experiments made by Conradi indicated that during the summer adult weevils can live without food for as much as seven days, and during winter for as much as thirteen days. However, the length of adult weevil life in the absence of food is not of particular consequence, inasmuch as weevils in the field are able at all times to find vegetation upon which they can feed.

Host Plants

The sweet potato and morning-glory are the preferred plants for feeding purposes, although the adult weevil is able to feed upon a great variety of vegetation. Conradi was able to keep the weevils alive for fifty-five days when they were fed upon buckwheat and for at least twenty-eight days when fed on melons. So far as known, experiments have not yet been made to determine how long the adult weevils can live if furnished with sweet potatoes upon which to feed. The sweet potato and morning glory and very closely related vines are the only ones in which the eggs and larvae have been found.

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In September, 1917, Mr. Bragdon found the weevil heavily infesting the stems and roots of the "sea-bean" *(Ipoemea Pes-Caprae* (L) Sweet*)*, on Sanibel Island. On Captiva Island he found a plant, as yet unidentified*, the stems and roots of which were also heavily infested.

It seems not impossible that other plants belonging to the same family (Convolvulaceae) may be possible hosts. Such plants should at least be regarded with suspicion.

Susceptibility of Different Varieties

No variety of sweet potato has been found immune to the weevil, although Mr. E. R. Potter noticed in an infested field which contained both Porto Rico yams and Nancy Hall plants that the weevils were very much more abundant on the latter than on the yams. It is very doubtful if any variety of sweet potato is sufficiently resistant to make possible its profitable cultivation in the presence of a heavy infestation.

Methods of Dissemination

Although the insect possesses well developed wings, it has in only one or two instances been observed to fly and the slow rate at which it spreads after being established in a community indicates that flight rarely if ever occurs. The principal means by which the insect is disseminated from one locality to another and from one farm to another is in the movement of infested sweet potatoes and sweet potato plants. There is no doubt but what the insect was first introduced into the Western Hemisphere from the Orient in infested potatoes and the distribution to various points in the Gulf States has been by the same method. That the insect has not already become generally distributed over the Gulf States is probably due to the fact that until recent years the sweet potato was largely a local crop, farmers as a rule not growing more sweet potatoes than could be used by local merchants or by near-by cities. In a similar manner, the farmer usually propagated plants from tubers of his own raising or secured plants from a near-by neighbor. Within recent years, following the introduction of new varieties and the supposed improvement of others, individuals have engaged in the business of growing sweet potato plants for sale. Dealers in plants have advertised their product through the agricultural press with the result that many thousands of plants are annually shipped by indi-

*Probably a species of *Ipoemea*.

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vidual dealers. It can readily be seen that if such a dealer were to ship infested plants he could be responsible in a single season for the pest becoming established in many new localities.

The shipment to market of infested tubers has also doubtless been responsible for much of the spread. Unless the potatoes are fumigated at the time of digging or before shipment the weevils continue to breed in them for an indefinite period. Strangely enough, farmers themselves sometimes buy sweet potatoes in the stores and if a farmer buys sweet potatoes and finds some of them infested by the grubs of the weevil, his first inclination is to throw them out for hogs or cattle to eat, thus affording opportunity for the insects to become established on his own farm.

Natural Control

The sweet potato weevil seems to be singularly free from natural enemies. No parasite has thus far been found to attack the weevil and there are no observations on record of birds destroying them. Strangely enough, the insect appears to be one which finds the most favorable conditions for its development in the area lying within approximately seventy miles of the Gulf Coast and the Atlantic Coast. The insect is able to survive the winters and to continue breeding at points much more than seventy miles from the Gulf Coast, but at points more than seventy miles from salt water maximum injury to the crop is not experienced. This can hardly be due to a natural check on the weevil because of low temperatures during the winter. The weevil is able to withstand temperatures which ordinarily are not experienced except at points as far north as central Georgia and central Alabama. In his experiments with the weevil, Professor Conradi found that adult weevils successfully withstood a temperature of 20° for a period of thirty minutes. When adults were subjected to a temperature of twenty degrees for one hour, 84% of them were killed; and at a temperature of 10° for two hours all adults were killed. These experiments were of course made with the adults exposed to the degree of temperature mentioned. In the field many weevils would find protection in the sweet potato tubers or beneath trash or in the ground where, with an air temperature of ten degrees, the weevil would not experience a temperature much below freezing. There are no grounds, therefore, for believing that winter temperatures are responsible for the weevil not extending its destructiveness to areas more than seventy miles from salt water. Although it is well known that

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certain insects and certain plants habitually confine themselves to the same area in the coastal plain, the exact reason for this limitation of advantageous natural conditions is not clearly understood. There is no apparent reason for believing that the lowest temperature experienced, even in northern Florida, will serve as a natural check to the insect. The temperature experienced during February, 1917, when the temperature fell as low as eighteen degrees at Gainesville and even lower in northern portions of the State, was not sufficient to perceptibly reduce the number of weevils in Baker County. It is obvious that the sweet potato industry of Florida must depend upon so-called "artificial" methods for the control of this insect.

Artificial Control

The control of the pest may be considered under two distinct heads: that of preventing the further spread of the pest to new localities, and the reduction of damage to the crop in the areas which are already infested.

Quarantine Measures

During the past season, the State Plant Board was active in calling the seriousness of this pest to the attention of the growers and dealers who make a business of selling and distributing sweet potato plants. The Plant Commissioner urged upon such dealers the advisability of having their premises inspected by the Board's inspectors and the subsequent use of an inspection certificate upon all plants shipped by them, in order that their customers might know that they were not receiving plants from infested fields. A considerable number of progressive dealers availed themselves of this plan and as a result many thousands of certified shipments of sweet potato plants were made by Florida dealers during the spring and early summer of 1917. It is interesting to note, in this connection, that out of the dealers' plantings which were inspected two were found in which the sweet potato weevil occurred. These dealers did not afterwards ship plants.

The Plant Board has for several months seriously and carefully studied methods for preventing the spread of the weevil to those localities in Florida not yet infested. In the first place, experience showed that infested plants and tubers were being shipped into Florida from other states and countries. For example, the number of plant and tuber shipments arriving at Tampa and Key West from Cuba heavily infested with the weevil was a source of surprise and grave concern. All infested

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shipments arriving were of course refused delivery in Florida and were either returned to the original shipping point or destroyed by the Plant Board inspectors. However, this experience showed conclusively that there would be no use in attempting the control or eradication of the sweet potato root weevil in Florida unless the further shipment of infested material from other states and countries was stopped. It was self-evident that the Plant Board could not undertake to inform itself as to all infested and non-infested sections in the other states and in the West Indian Islands. The only way that the influx of infested material could be stopped was to adopt a quarantine measure which prohibited the further shipment of host plants of the weevil into Florida. Such a quarantine was inaugurated by the Plant Board on July 23, 1917, when it adopted the following rule:

> "Rule 32. In order to prevent the introduction of the destructive insect enemy of sweet potatoes, known as the Sweet Potato Root Weevil *(Cylas formicarius)*, the importation into Florida of all sweet potato tubers, sweet potato plants, vines, cuttings, draws and slips and of all morning glory vines, cuttings, tubers or roots is hereby prohibited: provided, that this rule shall not be construed as prohibiting the importation of canned sweet potatoes and provided, further, that the importation of limited quantities of new or rare varieties may be allowed by special permit of the Plant Commissioner under such safeguards and precautions as he may specify. Application for such permits must be made to the Plant Commissioner, Gainesville, Fla."

Preventing the further shipment of sweet potato root weevils into Florida with infested tubers and plants constituted of course only one step in preventing distribution, for the infested areas in Florida still presented a menace so far as the remainder of the State was concerned. A similar quarantine was placed on the infested Florida areas by action of the Plant Board taken on September 13, 1917, when rules were adopted prohibiting absolutely the movement of sweet potato plants out of any infested Florida locality and prohibiting the movement of sweet potato tubers out of infested Florida localities to non-infested areas unless first fumigated under the personal supervision of an inspector. The quarantine rules adopted by the Board September 13th, together with the Public Notice defining the infested Florida areas, are as follows:

> "Rule 33. The movement or shipment of sweet potato slips, draws, vines, plants and cuttings and of morning glory tubers, roots, vines and parts thereof, from the areas designated in the Public Notices by the State Plant Board as areas in which the Sweet Potato Root Weevil *(Cylas formicarius* Fab.) occurs or which are infested by said weevil, into or through all parts of the

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State of Florida other than those specified as infested areas, is hereby prohibited."

"Rule 34. The movement or shipment of sweet potato tubers from the areas designated in the Public Notices of the State Plant Board as areas in which the Sweet Potato Root Weevil *(Cylas formicarius* Fab.) occurs or which are infested by said weevil, into all parts of the State of Florida other than those specified as infested areas, unless first fumigated under the personal supervision of an Agent of the Plant Board and certified by him, is hereby prohibited; provided, that this rule shall not be construed as preventing the shipment of sweet potato tubers from infested sections in the State of Florida to points in other states when such tubers are securely sacked and shipped in tightly closed cars in carload shipments and provided, further, that this rule shall not be construed as preventing the shipment of canned sweet potatoes."

Public Notice

"Under the provisions of the Florida Plant Act of 1915, Chapter 6885 of the Laws of Florida, the State Plant Board, in session at Jacksonville, Florida, this 13th day of September, 1917, and in accordance with Section 12 of said Act, does declare and give public notice thereof that the Sweet Potato Root Weevil *(Cylas formicarius* Fab.) is an insect pest the dissemination of which should be prevented, that sweet potato plants, vines, slips, cuttings, draws and tubers and morning glory *(Ipomoea* sp.*)* vines and roots are plants likely to become infested by said insect pest and that the following areas are areas within the State of Florida in which said insect pest is known to occur: the Counties of Baker, Brevard, St. Lucie, Palm Beach, Broward, Dade and Monroe and Sanibel Island, Captiva Island and Buck Key in Lee County."*

Under the foregoing regulations, farmers in the infested areas must find a market for their sweet potato crop either within these infested areas or in some other State, or must have their sweet potato tubers fumigated before shipping them to any non-infested section in the State of Florida.

Full compliance with the rules and regulations of the Plant Board by the farmers in the infested sections and precaution on the part of farmers in the non-infested sections to secure no sweet potatoes or potato plants from infested areas should materially check the further distribution of the pest. Those who have occasion to purchase sweet potato plants should insist imperatively upon their purchases being accompanied by the inspection certificate of the State Plant Board.

Fumigation

All stages of the weevil in sweet potatoes can, according to the experiments made by Conradi, be destroyed by fumigation of the tubers in a tight compartment, using three pounds of carbon bisulphide to each one thousand cubic feet of space, and keeping the compartment tightly closed for thirty hours. One condition to the success of the fumigation, however, is the

*Since adoption of the above public notice infestation by the weevil has been found in Volusia County.—W. N.

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use of a practically air-tight compartment in which the fumigation is made. For small quantities of potatoes a tight barrel such as an alcohol, formaldehyde or vinegar barrel, can be used. The potatoes are placed in the barrel, either loose or in sacks, a shallow vessel placed on top of them, and the requisite amount of carbon bisulphide poured into the vessel, and the top of the barrel covered with an oiled canvas* held in position by an extra barrel hoop driven down tightly over it. For fumigation of larger quantities an airtight room, safely removed from other buildings, is necessary. (Carbon bisulphide is inflammable and its vapor explosive; no fire or lights should be allowed near where it is stored or used.)

Reducing Damage on Infested Farms

No entirely satisfactory means of controlling the weevil or eliminating the damage has been devised. There are certain steps, however, which the farmer can take to materially reduce the damage by the weevil. No one of the measures mentioned below is sufficient to insure even a small part of the crop being free from grubs and weevils, but a combination of all these measures, if generally employed throughout a community, or even on a single farm, will bring about a very noticeable reduction in the number of weevils and in the extent of damage. The control measures which have thus far been found useful may be summarized as follows:

1. Sweet potatoes should not be planted upon land in which sweet potatoes were grown the year before, and preferably each planting should be placed as far as possible from any other sweet potato patches. This makes it more difficult for the insects living through the winter to find the plantings in the spring.

2. The farmer should be sure that he is using plants which have come from a field or locality where the sweet potato root weevil does not occur.

3. No "hold-over" potatoes should be allowed to remain in the field during the winter. The custom of planting potatoes late in the season and leaving the tubers in the ground to mature early the following summer is a practice which affords the weevil a continuous supply of food and continuous breeding quarters throughout the entire season. This practice should be entirely abandoned in the infested areas.

4. As far as possible all morning-glories of every kind

* The heavier the canvas used, the better. It can be rendered gastight by soaking for a short time in linseed oil, wringing out the excess oil, and then drying in some place protected from direct sunlight.

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should be exterminated in the vicinity of potato fields. Roots of the morning-glory are as acceptable to the weevil for breeding places as are sweet potato tubers, and morning-glories, wherever found, should be dug out by the roots and the vines and roots burned. Use of morning-glories as ornamentals, in the infested areas, should be discontinued.

5. When the potatoes are harvested, extreme pains should be taken to secure every tuber in the field. All vines, damaged tubers, fragments of roots, etc., should be completely burned at time of harvest. The field should then be plowed and cross-harrowed, pains being taken to get every particle of potato, potato root or vine and these destroyed by burning. Hogs can then be turned into the field to hunt out any potatoes which have escaped the owner.

6. The field should be closely watched the following spring and if any volunteer plants appear, they should be at once dug up, tubers and all, and burned. As soon as the potatoes are dug they should be fumigated with carbon bisulphide to kill all weevil stages in them. If they are to be kept in storage on the farm, they should be placed in a compartment which has not been previously used for sweet potatoes (unless first thoroughly cleaned out and disinfected). This compartment should be screened for the double purpose of preventing weevils getting to the fumigated sweet potatoes and starting a new infestation in them and of preventing the escape of any weevils which might hatch in the potatoes themselves. This also serves as an additional check upon the efficiency of the fumigation.

7. Extremely early planting in the spring should be discouraged. Experience in Texas and Louisiana has shown that late plantings experience less damage than the early ones, probably because in the case of early plantings the insects have a longer time in which to reproduce and increase before tubers reach proper size for digging.

8. When planting use plants from a locality in which the weevil does not occur, and insist upon such plants, when purchased, being accompanied by the inspection certificate of the State Plant Board.

9. If necessary to produce home-grown draws in the infested territory, use only clean, sound tubers which have been fumigated and bed the tubers in a field or lot considerably removed from the main field. In other words, do not have beds or draws adjacent to the fields that are to be planted out.

10. Never throw out infested potatoes or potatoes which are

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partly decayed or injured. All these should be burned up or, if it is desired to use them for feeding to stock, they should first be boiled, and any remnants left by the stock should be carefully gathered up and burned. It should be remembered that every particle of potato tuber, either above the ground or below it, outdoors or in, may become a breeding place for weevils which will attack the following year's crop.

Each farmer *in territory free from the pest* should raise enough potatoes for his own use throughout the year and thus avoid the risk of infesting his place by buying potatoes on the market.

Spraying

Experiments were made by Conradi in spraying vines with arsenical poisons in the attempt to kill the adult weevils. While these experiments were not extensive enough to justify the conclusion that the use of arsenical poisons would be found practical under field conditions, the possibility of using lead arsenate is at least indicated. The spraying of young vines with a lead arsenate mixture, 2 or 3 lbs. to 50 gallons of water should, in the absence of other food plants in the field, kill some of the adult weevils. This might prove a useful supplementary measure to the steps described above, especially early in the season while the plants are still comparatively small.

Damage to Potatoes in Storage

At ordinary temperatures the weevil continues its work in stored tubers and the temperature during the winter months in Florida is rarely low enough to interfere with its development.

No careful experiments have been made to determine to how high a temperature tubers must be subjected in order to kill all weevil stages in them, but from what is known regarding the effect of heat upon other weevils it is a fairly safe conclusion that the tubers would have to be heated through and through to a temperature of at least 122 degrees F. and this temperature maintained for several hours. Tubers which have been kiln-dried or otherwise cured are not exempt from attack by the pest.

Eradication Experiments

From the known habits of the sweet potato root weevil and the manner in which it is disseminated, it apparently would be possible to eradicate it much in the same manner that citrus

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canker is being now eradicated from the citrus groves of Florida. However, it is not the policy of the Plant Board to condemn infested fields but rather to, first, prevent further distribution and, secondly, to assist the farmers in the infested areas to reduce the pest as rapidly as possible—and perhaps wipe it out entirely—the farmers at the same time continuing the raising of sweet potatoes on as large a scale as may be desired. Where small isolated infestations occur it will undoubtedly be profitable, both for the owners and the community, to wipe out the infested fields at once.

The complete and immediate eradication of the insect, in large areas which are generally infested, would involve the expenditure of a considerable amount of money and would require in addition the full co-operation of all farmers and business interests. Whether such extensive steps will be taken by the Plant Board in the future will of course depend upon the extent to which the farmers in the infested areas demand this assistance and the extent to which appropriations are provided for the purpose. There appears no good reason, however, for believing that isolated outbreaks, consisting of a few infested fields, cannot be eradicated with a minimum of cost. An attempt of this kind has recently been made by the State Plant Board in Hillsboro County.

On August 31, 1917, Inspector Harry B. Barnett learned of the presence of the weevil in a potato field belonging to Mr. L. E. Mobley at Citrus Park. Mr. Mobley's field consisted of about one-fourth of an acre of sweet potatoes and there were no sweet potato fields nearer to it than half a mile. Inspection of the latter fields showed no weevils. Arrangements were immediately made with Mr. Mobley for an experimental attempt to eradicate the pest. The following methods were employed:

The entire potato field was sprayed with kerosene for the purpose of destroying any adult weevils crawling about on the vines and for reducing the chances of any escaping from the field during the subsequent operations.

All potato vines were cut and burned upon a log fire. The tubers were then dug with care, pains being taken to get all of the tubers and as many of the roots as possible. The tubers and the roots were also burned. The field was then plowed, inspectors following the plow and picking up all roots, pieces of stem, tubers, etc., and burning these. The field was then harrowed several times and the same cleaning and picking process

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continued until it seemed certain that every particle of sweet potato plant had been removed and burned.

The succeeding operations were divided into two parts. The first consisted of carefully examining all fields and premises in the vicinity for morning-glory vines, and wherever these were found they were uprooted and burned. In the field itself, immediately following the destruction of the plants and tubers and the plowing of the field, clean sweet potatoes (which came from an area not infested by the weevil) were used as "traps" for catching any weevils which escaped the general destruction of the potato patch. These clean potatoes were placed in various parts of the field, each potato being partially buried in the ground. It was assumed from the known habits of the insect that any weevils remaining in the field would be attracted to these potatoes. The subsequent program included daily visits to these potatoes and the destruction of any adult weevils found on them. During the nine weeks following the placing of these "traps," 169 adult weevils were collected from them. At the end of the first week these potatoes were taken up and burned for the purpose of destroying any eggs which had been deposited in them during the week. The plan calls for the continuation of this practice, that is, the replacing of the trap potatoes and their destruction weekly, for the remainder of the season.

While this work was in progress another field in the neighborhood was found on closer inspection to be very lightly infested. In the case of this field the same steps were taken.

As a part of this attempt to eradicate this weevil outbreak, the farmers whose fields are nearest to Mr. Mobley's will be asked at time of digging their potatoes this fall to fumigate these potatoes whether they show infestation or not, and to destroy completely all remnants of the crop, such as vines, stems, etc.

This experiment has of course been carried out largely on theoretical grounds, and the outcome of it will be watched with a great deal of interest by both the State Plant Board employees and by the farmers, for in case the experiment is successful and this infestation is eradicated, there is no reason why the same methods cannot be employed in the case of other sporadic outbreaks or even in localities where the infestation is quite extensive. If, on the other hand, the steps taken do not result in complete eradication of the weevil in that locality, there will be opportunity to inquire as to the reasons why it

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was not successful. Regardless of the results secured, the information will be of value in the future campaign against this pest.

Federal Recognition of the Eradication Campaign

The U. S. Department of Agriculture has fully recognized the dangerous nature of the sweet potato root weevil, as well as the practicability of undertaking its eradication on an extensive scale. On July 1, 1917, at a conference held between Dr. F. H. Chittenden, of the Bureau of Entomology, and the writer, Doctor Chittenden expressed the opinion that in the light of his knowledge of this insect, there was no good reason why it should not be completely eradicated from the United States provided the work were properly managed and a sufficient amount of money made available for the purpose. The matter was duly brought to the attention of the Honorable Secretary of Agriculture, David F. Houston, and as a result the sum of $10,000.00 has been set aside out of the sum allotted for the suppression of insects injurious to truck crops, available under the provisions of the Food Production Act, approved August 10, 1917, the $10,000.00 to be used by the Bureau of Entomology, U. S. Department of Agriculture, in preliminary survey work and demonstration methods in the states where the weevil occurs. It is to be hoped that this is only the beginning of a systematic attempt upon the part of state authorities in the Gulf States, in cooperation with the federal government, to completely dispose of this insect for good and all times.

Literature

Following is a list of the principal publications regarding the sweet potato root weevil which have come to our attention. No attempt is made to include in this list all references to the species and where no information of practical interest is contained in a paper we have purposely omitted reference to it.

Comstock, J. H. Report of the Entomologist. Report of the U. S. Commissioner of Agriculture for the Year 1879, pp. 249-250. (1879).
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Newell & Rosenfeld. Journal of Economic Entomology, I, p. 153 (1908).
Newell & Rosenfeld. Circ. 27, La. Crop Pest Commission, p. 104 (1909).
Chittenden, F. H. Insects Injurious to Vegetation, p. 235 (1912).
Chittenden, F. H. Bul. 82, Bur. of Entomology, U. S. D. A., p. 90 (1909).
Barr & Conradi. Bul. 141, South Car. Exp. Station, p. 49 (1909).
Sanderson, E. D. Insect Pests of Farm Orchard & Garden, p. 438 (1912).

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WATSON, J. R. Sweet-Potato Root-Weevils. Press Bulletin No. 284, Fla. Experiment Station (1917).
STATE PLANT BOARD OF FLA. Circulars 18, 20, 23 and 24 (1917).
BRAGDON, K. E. The Sweet Potato Root Weevil in Florida. Florida Buggist, I, No. 2 (1917).

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING SEPTEMBER 30, 1917

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending September 30th has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING SEPTEMBER 30, 1917

Citrus grove trees inspected	2,716,704
Citrus nursery trees inspected	10,234,981
Inspectors employed	322
New properties showing infection	2
Total properties showing active infection	22
Grove trees found infected	75
Nursery trees found infected	0
Counties in which active infections were found	7

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,704
Nursery trees found infected since May, 1914	342,254
Number properties infected to September 30, 1917	475
(This number includes seven (7) properties which have shown re-infection. When parts of infected properties have been sold the portion disposed of, when infected, is carried as another infected property under the name of the new owner.)	
Properties declared no longer "danger centers"	340
Properties still classed as "infected" September 30, 1917	135

Note: A revision and tabulation of the records has necessitated some changes in this report as compared with preceding reports.

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to September 30, 1917:

1914		1915		1916		1917	
		Jan.	306	Jan.	86	Jan.	14
		Feb.	165	Feb.	21	Feb.	4
		March	444	March	49	March	9
		April	408	April	49	April	169
May	108	May	1042	May	338	May	52
June	160	June	772	June	450	June	45
July	275	July	651	July	349	July	39
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30
Sept.	767	Sept.	618	Sept.	124	Sept.	6
Oct.	565	Oct.	214	Oct.	451		
Nov.	773	Nov.	494	Nov.	131		
Dec.	366	Dec.	256	Dec.	27		

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DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING SEPTEMBER 30, 1917

The following report on the inspection of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

SHIPS AND VESSELS INSPECTED:

From foreign ports	351	
From U. S. ports other than Florida	211	
From Florida ports	406	
Total		968

SHIPMENTS INSPECTED:

Arriving by water:		
Passed	114	
Treated and passed	7	
Returned to shipper	19	
Detained, subject to return by shipper	1	
Contraband destroyed	232	
		373
Arriving by express, freight, etc.:		
Passed	114	
Treated and passed	26	
Returned to shipper	24	
Detained, subject to return to shipper	23	
Contraband destroyed	9	
		196
Total shipments inspected		569

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of shipments infested.
Cactus scale	Cactus	Cuba	1
California black scale	*Eugenia malaccensis*	Cuba	1
California black scale	Sago palm	Cuba	1
Chaff scale	Citrus	Cuba	1
Citrus mealy-bug	Guava	Florida	1
Cocoanut mealy-bug	Cassava	Cuba	1
Cocoanut mealy-bug	*Ochrocarpos africanus*	Cuba	1
Cocoanut mealy-bug	Palm	Cuba	1
Crown gall	Rose	Cuba	1
Crown gall	Rose	Florida	1
Cyanophyllum scale	Palm	Cuba	1
Dictyospermum scale	Bahia	Cuba	1
Dictyospermum scale	*Eugenia malaccensis*	Cuba	1
Florida red scale	Citrus	Cuba	1
Florida red scale	Citrus	Florida	1
Florida red scale	Rose	Cuba	1
Florida red scale	Rubber plant	Florida	1
Hemisphaerical scale	Sago palm	Cuba	1
Lesser snow scale	Bahia	Cuba	1
Lesser snow scale	Palm	Cuba	1
Lesser snow scale	Cassava	Cuba	1
Long scale	Citrus	Cuba	1
Mango scale	Mango	Cuba	1
Mealy-bug	Rose	Cuba	1
Mealy-bug	Sago palm	Cuba	1
Melanose	Citrus	Cuba	1
Mining scale	*Casuarina stricta*	Cuba	1

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Insect or Disease	Occurring on	From	Number of shipments infested.
Mining scale	*Jacobinia mohintli*	Cuba	1
Nematode root-knot	Fig	Cuba	1
Nematode root-knot	Fig	Florida	2
Nematode root-knot	Peach	Florida	1
Nematode root-knot	Rose	Florida	1
Nematode root-knot	Spirea	Florida	1
Oleander scale	Brunfelsia	Cuba	1
Oleander scale	Japonica	Cuba	1
Oleander scale	Lantana	Cuba	1
Oleander scale	Mammee apple	Cuba	1
Oleander scale	*Ochrocarpos africanus*	Cuba	1
Oleander scale	Sago palm	Cuba	1
Papaya fruit-fly	Papaya	Florida	1
Pineapple scale	Pineapple	Cuba	1
Purple scale	Citrus	Cuba	3
Purple scale	Citrus	Florida	2
Red bay scale	Unknown plant	Cuba	1
Rufous scale	Brunfelsia	Cuba	1
Rufous scale	Citrus	Cuba	3
San Jose scale	Peach	Florida	1
San Jose scale	Peach	So. Carolina	1
San Jose scale	Rose	Florida	1
Soft brown scale	Acalypha	Florida	1
Soft brown scale	Chrysanthemum	Florida	1
Soft brown scale	Guava	Florida	1
Soft brown scale	*Pseuderanthemum*	Cuba	1
Sweet potato root weevil	Sweet potato	Cuba	4
Whitefly	Citrus	Alabama	1
Whitefly	Citrus	Cuba	2
Whitefly	Jasimine	Florida	1
Whitefly	Jasimine	So. Carolina	1
White peach scale	Bahia	Cuba	1

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PARCEL POST PLANT INSPECTION

QUARTER ENDING SEPTEMBER 30, 1917

PARCELS INSPECTED:

Passed	119	
Treated and passed	0	
Returned to sender	0	
Detained, subject to return	9	
Infested or infected parcels destroyed	3	
Total Parcels Inspected		131

PESTS INTERCEPTED

Insect or Disease	Occurring on	From	Number of shipments infested.
Citrus mealy-bug	Coleus	Ohio	5
Citrus mealy-bug	Coleus	Pennsylvania	1
Lace bug	Rhododendron	Tennessee	1
Nematode root-knot	Begonia	Illinois	1
Nematode root-knot	Chrysanthemum	Ohio	1
Nematode root-knot	*Clematis paniculata*	New York	1
Nematode root-knot	Coleus	Ohio	3
Nematode root-knot	Geranium	New York	1
Nematode root-knot	Rose	Ohio	2
San Jose scale	Peach	Ohio	1
San Jose scale	Pear	Ohio	1
San Jose scale	Plum	Ohio	1

THE PINEAPPLE BLACK WEEVIL

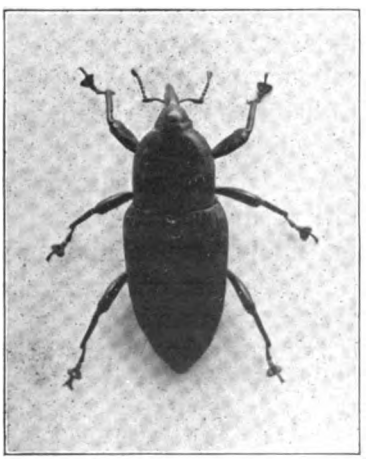

Fig. 73.—The Pineapple Black Weevil, *Metamasius ritchiei* Marshall (from a photograph by Mr. Archibald H. Ritchie).

Through the courtesy of Mr. Archibald Ritchie, Government Entomologist of Jamaica, we are able to present this photograph of the above insect, a description of which was given in The Quarterly Bulletin, Vol. 1, p. 47 (Jan., 1917).

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

ASSOCIATE EDITORS.

E. W. BERGER.....*Entomologist*
F. M. O'BYRNE.....*Nursery Inspector*
R. A. JEHLE.....*Asst. Plant Pathologist*
FRANK STIRLING.....*General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

THE ROLL OF HONOR. One realizes that we are at war only when friends or loved ones are called to the colors. Twenty-six of the Plant Board employees have answered the "call" and it is with pride that we print their names on the opening page of this issue. Truly it is a "Roll of Honor", this list of husky young men who have given up home and ambitions to perform the sternest duties of which men are capable and to lay down their lives in the performance if need be. Florida, from a selfish standpoint, can ill afford to spare these men, with their experience in battling with agricultural and horticultural enemies, at a time when many new enemies are knocking at our doors. Yet we spare these men willingly, knowing that they are going to a still greater duty and that they will not be found wanting. The latch string will be out, and the glad hand waiting for them, when they come back.

As far as possible the State Plant Board will hold positions for its employees who are in the military service. At its meeting at Miami on October 8th the Board adopted the following resolution:

"WHEREAS, it is the desire of the State Plant Board of Florida to do everything within its power to facilitate the activities of the military authorities of the country at this time, and

"WHEREAS, many employees of the State Plant Board have

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voluntarily enlisted in the United States Army and Navy and others have been drafted into said service, and

"WHEREAS, it is the desire of the State Plant Board to provide as far as possible for its employees upon their return from military duty, therefore

"BE IT RESOLVED that, wherever possible, positions made vacant in the State Plant Board work by reason of enlistments or service of the incumbents in the United States Army or Navy be held available for such parties upon their return from military service."

SCALE-INSECTS. No group of insects causes as much loss to fruit growers in the aggregate, as the scale-insects. Small though they are, their ability to increase with great rapidity makes them mighty in their powers of destructiveness. In this issue we present a paper by Mr. C. E. Wilson, until recently Assistant Entomologist of the Plant Board, giving descriptions of 87 species of "scales" found in Florida. Every kind and variety seems to be represented. Here are scales that have come from the tropics, from the extreme North and from the extreme South, from Europe, Asia, Africa and the Islands of the Indian Ocean. What a monument to the indifference with which Florida regarded such dangers until three years ago! From the beginning of American history until the passage of the Florida Plant Act in 1915, our State was a free dumping ground for insect-infested and diseased plants. The farmers, fruit growers and truckers are now paying for all those years of indifference and, strange as it may seem, there are a few who feel that a Plant Board should, in two or three years, control or eradicate all of these introduced pests and thus undo at once all the damage done during more than a half century of neglect!

Fortunately, Florida did not get *all* the pests in the world before she began putting up the bars, but unless the bars are kept up and the protective quarantine made ever stronger and better worse enemies than any we have yet had will be upon us. It appears that the turning point towards victory has been reached in the canker fight and though cases of canker will still be found and many months of tedious inspection are still ahead of us, it is now a certainty that canker *can* be eradicated and that it is *being* eradicated. Let us hope that our experience with canker may never be duplicated by a similar experience with any other menace of like character, but eternal vigilance, effective quarantines, and strict regulations governing the sale

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and movement of trees and plants are the only things that can grant us immunity from calamities and near-calamities in the future.

Not only must our efforts be directed to keeping out additional enemies of this character, but the campaign must go on relentlessly against those we already have with us. It is but proper, therefore, that we should also present a comprehensive article by Dr. E. W. Berger, Entomologist of the Plant Board, on the practical control of scale-insects. The grower will find in Dr. Berger's article the principles upon which successful control of these insects is based, together with a full discussion of what sprays to use, how to make them and how to apply them.

THE REDLANDS LABORATORY. On October 9th the Plant Board held a well attended public meeting in the League Hall and laboratory in south Dade County. The question as to whether the citrus canker investigations should be continued at the laboratory appeared to be the topic of the hour and was freely discussed. Inasmuch as these investigations have required the maintenance of infected trees in the screened cage connected with the laboratory, many of the growers thought these would be a source of danger in event of a hurricane. The possibility of a storm of sufficient intensity to destroy the cage and scatter its contents must be admitted. Hurricanes in other States have demonstrated their ability to disseminate canker over large areas. The investigations at the laboratory, by Dr. R. A. Jehle, have added much useful information to our knowledge of this disease and there appears no good reason why canker should be longer kept on hand, even in a cage. No "cure" for citrus canker has been discovered but it is now evident that a cure will not be needed for the success of the eradication work is assured. The canker investigations at the Redlands laboratory will, therefore, be discontinued although much of the laboratory equipment will be retained and used, as occasion may arise, for the investigation of other diseases.

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Vol. II JANUARY, 1918 No. 2

THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by

STATE PLANT BOARD OF FLORIDA

GAINESVILLE, FLA.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

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STATE PLANT BOARD
Of Florida

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J. H. MONTGOMERY, *General Grove Supervisor*	Gainesville

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. II JANUARY, 1918 No. 2

ROLL OF HONOR

The following employees of the State Plant Board of Florida are serving in the several branches of the military service:

Ball, Jos. H.	Aviation Section
Barcus, Geo. D.	Aviation Section
Bradford, Horace	Federalized Nat'l Guard
Branam, Jas. R.	Navy
Briggs, Wynfred R.	Officers Reserve Corps
Butts, John L.	Aviation Section
Bynum, Eli K.	Field Hospital
Carothers, A. B.	Officers Reserve Corps
Cary, Chas. L.	National Army
Calcote, Wm. H.	Officers Reserve Corps
Chandler, L. L.	Navy
Dickey, Ed. K.	Aviation Section
Dickson, Albert M.	Officers Reserve Corps
Dukes, Redding A.*	National Army
Fletcher, J. M.	Aviation Section
Fogg, Harry W.	National Army
Goldsby, Jack K.	Ambulance Corps
Green, Guilford	1st Lieut. Fed. Nat'l Guard
Grimes, D. W.	Aviation Section
Harn, Sam P.	Naval Reserve Corps
Harrison, Cyrus J.	Aviation Section
Henderson, Francis M.	National Army
Hood, Richard Van	Lieut. Marine Corps
Howell, John F.	Officers Reserve Corps
Little, Floyd L.	Aviation Section
Lovett, J. C.	National Army
McClanahan, Howard S.	Naval Reserve
McCullough, Jas. C.	National Army
Maloney, Clarence B.	Royal Flying Corps
Miller, Herbert L.	Aviation Section
Moore, Jos. W.	Navy
Moore, Jules B.	Engineering Corps
Neal, Cecil G.	Officers Reserve Corps
Niedernhoefer, Wm. F.	Aviation Section
Roberts, Samuel F.	Quartermaster's Dept.
Robinson, Tom	Navy
Seeds, Harvey W.	National Army

*Deceased.

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where he interested a company owning large tracts of land in the planting of Egyptian cotton in that country. In 1911 this company imported one hundred and twenty-five sacks of Egyptian cotton seed which was planted in the immediate vicinity of Monterey. This seed was not disinfected and must have been infested by the pink bollworm. Naturally the infestation did not develop to any great extent with the first crop, which was large and attracted considerable attention. As a consequence much of the seed produced was shipped for planting to the Laguna region where the bulk of the Mexican cotton is produced. In this way the pink bollworm was spread in a very short time throughout a large territory in Mexico. It has been found that practically all of the plantations in the Laguna are now infested. Some of them showed a falling off in the crop of 1917 of from fifty to seventy-five per cent.

Two other infestations in Mexico are known to have resulted from seed shipped for planting purposes from the Laguna. One of these localities is near Allende, about forty miles south of Eagle Pass. The other is immediately opposite Del Rio, Texas, where about two hundred and fifty bushels of Laguna seed were planted in 1917.

The determination that the pink bollworm occurs in Mexico was made early in November, 1916, as the result of the sending of specimens of what was recognized as a new pest from a plantation in the Laguna via Mexico City to Washington. As soon as this information was at hand the Federal Horticultural Board stopped the further importations of seed, and began energetic steps to remove the danger of the infestation of the Texas fields as the result of the arrival of the seed which had been shipped in during the several preceding months.

Introduction in the United States

In 1916, for various economic reasons, large quantities of Mexican seed were shipped to the United States. The total amounted to more than five hundred carloads. This seed was shipped to eleven mills in Texas for crushing.

The first step taken by the Federal Horticultural Board was to trace the various carloads of seed to their destinations and as far as possible to expedite crushing. Customs house records made it possible to locate all of the seed without difficulty. The mill owners were called together; the danger was explained and co-operation was immediately forthcoming in all of the sugges-

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tions made by the Department. As soon as seed could be crushed special means were taken to have all of the mill premises cleaned; that is, the chutes, conveyors and roadways were freed of cotton seed.

In 1917 a number of special men were employed to scout the fields growing in the vicinities of the mills which had received Mexican seed. This work was continued actively throughout the season. In September one slight infestation was found in the immediate vicinity of the mill at Hearne, and during the following month a similar infestation was found at Beaumont, where one hundred and fourteen carloads of seed had been received.

At both Hearne and Beaumont immediate steps were taken to destroy the infested fields and to safeguard in various ways the cotton and cotton products originating in the localities. The plants were uprooted or chopped down and burned with the aid of oil. The fields were then carefully gone over and all vestiges of cotton removed. Over seven thousand acres were treated in this way at an average cost of $10.72 per acre. The cotton products were exported as far as possible and the seed crushed under supervision.

Shortly after the discovery of the pink bollworm in Jefferson County the presence of the insect was determined at Anahuac on Galveston Bay. It was first thought that this infestation was

Fig. 79.—Laborers engaged, under direction of the Federal Horticultural Board, in destroying all cotton plants, bolls, locks and seeds in the area in southern Texas which was found infested by the pink bollworm in the latter part of 1917. (Photo by Ed. L. Ayers, Texas State Dept. of Agr.)

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due to the carriage of Mexican seed from Beaumont about sixty miles away. Most careful investigations, however, failed to reveal any proof that the Galveston Bay infestation was attributable to the Beaumont seed. As the investigations proceeded further infestation was found around Trinity Bay, extending as far as Galveston County.

The only explanation of the infestation around Galveston Bay which is at all satisfactory is that it was due to the washing ashore of a considerable number of bales of Mexican cotton in the great storm of August, 1915. Several thousand bales of this cotton have been traced to Galveston where they were on the docks at the time of the storm. Altogether more than twenty thousand bales of cotton, in which a portion of the Mexican bales were included, were washed ashore. They were salvaged at various points around Trinity Bay from Smith's Point on the East to Texas City on the West. In many cases the force of the water had broken the bands and the cotton with the contained seeds was scattered over a wide territory. A fact which tends to corroborate the theory of the establishment of the pink bollworm through the wreckage of the Mexican cotton is that the infestation has been found to be heavier near the water line and to become gradually less towards the interior. While it has not been possible to prove beyond all doubt that the foregoing is the true explanation of the origin of the Galveston Bay infestation, it is by far the most satisfactory theory which has been propounded. Mr. Busck, who is our leading authority on the pink bollworm, and who has studied it in Mexico, especially in relation to the degrees of infestation resulting from introduction at different dates, is convinced that it is not necessary to go back of 1915 to explain the situation around Trinity Bay, and that the natural spread of the insect and its carriage in seed for planting purposes from farm to farm would explain fully the extent of the infestation which has been found to exist.

Plan of Work Against the Pink Bollworm

The work which the Department of Agriculture has under way to remove the menace of the pink bollworm may be classified in five groups as follows:

1. Exclusion from the United States of cotton seed from all foreign countries.

2. The fumigation of all bales of foreign cotton, arriving

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at the United States, in vacuum chambers under Federal supervision.

3. The regulation of the traffic from Mexico, which includes the interior fumigation and the exterior spraying of all cars.

4. The eradication of the insect in Texas in co-operation with the State Department of Agriculture under a special law provided by the Legislature. This includes the operation of three cotton-free zones of considerable size.

5. Work in Mexico looking towards the eradication of the insect in that country to eliminate the possibility of further infestation of the United States from that source.

The importance of excluding all foreign cotton seed from the United States is evident and means have been provided by the Federal Horticultural Board in co-operation with the Customs Service to enforce the embargo. The only existing danger in this connection is in mail shipments, and efforts are being made to increase the extent of control over such shipments.

The United States normally receives about two hundred thousand bales of foreign cotton annually. This is all admitted under permits issued by the Federal Horticultural Board at specified ports including only Boston, New York and San Francisco. As a condition of entry the bales are all fumigated with hydrocyanic acid gas in vacuum chambers. This is the outcome of a long series of experiments performed at Washington and elsewhere in which it was determined that the system was effective and practicable.

The protection secured at the Mexican Border Ports is under strict rules and regulations, including the disinfection of freight, cars, baggage and express. The necessary men are located at all of the ports and the work now consists of excluding all cars which show traces of cotton seed as well as the fumigation of all commodities related to cotton, or which might by any possibility have been subjected to contamination. As there is a possibility that the pink bollworm moth might be brought in on the outside of cars, or on the running gear, the spraying of all cars which would possibly come in contact with the insect in Mexico is required.

A preceding paragraph has dealt with the work of the eradication of the insect in Texas, but an additional word should be given about the cotton-free zones. One of these is at Hearne, where the original infestation was found. It consists of a circular area with a radius of two and one-half miles about the

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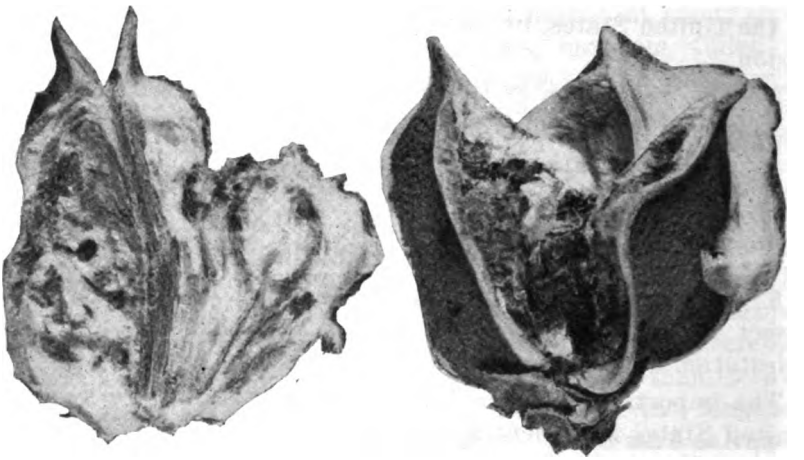

Fig. 80.—Cotton bolls showing injury by the pink bollworm, *Pectinophora gossypiella* Saunders. (Original.)

only fields which were found infested after very careful investigation. The second non-cotton area is in Southeastern Texas, and extends from Jefferson County on the East to include a portion of Fort Bend County on the West. This is by far the largest and most important of the cotton-free zones provided. The third consists of three counties on the Rio Grande opposite the infestation found in Northern Mexico.

There has naturally been some opposition to the establishment of cotton-free zones in Texas, especially in the Southeastern district, where the cultivation of cotton has been increased greatly within the last few years. The State officials, however, have been fully alive to the importance of the situation and the necessity of taking the most drastic steps provided for by law. The opposition has been local. The great majority of the farmers in the district have been quite in sympathy with the work. At the present writing it is evident that local opposition is diminishing, and there is every indication that a satisfactory, absolute cotton-free zone will be provided.

It is proposed to prohibit the planting of cotton in these zones for a period of three years.

The work in Mexico, which is under the direction of Mr. August Busck, consists of educational features looking toward co-operation with the planters and the Government in the eradication of the pest in the Laguna. Sufficient damage has been done in the Laguna to convince the planters that they must do something to protect their interests. The lands are controlled

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by comparatively few persons. The situation is isolated, and there is considerable probability that a voluntary cotton-free area will be established throughout the Laguna. Similar possibilities exist in the case of the two other infestations in Mexico to which reference has been made.

In connection with the general work in Mexico Mr. Busck has two technical assistants making a complete study of the life history and bionomics of the pink bollworm. The investigational work which has been done heretofore, while good in its way, was not under conditions closely approaching those of the United States. The Egyptian and Hawaiian observations need to be repeated and multiplied so that we will have the fullest possible information regarding the habits of the insect under such conditions as exist on this continent.

Nature and Amount of Damage

The pink bollworm affects cotton production in several ways. It destroys a certain number of bolls or portions of bolls in which case the lint produced is short and kinky. In some cases as much as 75 per cent of the crop is lost in this way. The injury however, does not end with the reduction of yield of lint. The crop of seed is correspondingly reduced and what is obtained is of light weight and poor grade. In the crushing of Egyptian seed in England it was found that the oil content was lower than normal by about 20 per cent, that the oil actually secured was of dark color, and comparatively low value. The work of the insect is also of importance in connection with seed for planting. The percentage of germination is naturally low and much larger quantities must be planted to secure a stand.

The most accurate information concerning the damage by the pink bollworm is in a recent paper by L. H. Gough. The investigator conducted studies in lower and middle Egypt to determine the number of bolls attacked by the pink bollworm. The samples consisted each of 100 green bolls taken at random in fields in various localities. These samples were sent to Cairo where they were given a very careful examination. The total number of bolls examined in this work was 106,400 and the examinations continued from July to November. The following are the results of this investigation:

Percentage infested during July less than 10.
Percentage infested during August from 10 to 25.
Percentage infested during September from 25 to 75.

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Percentage infested during October from 75 to 89.

These figures show in a very striking manner the great damage of which the pink bollworm is capable. They may be taken as a fair indication of the injury which would be done in the United States as the seasonal conditions here are similar to those in Egypt. In short, they show approximately 25 per cent of the August bolls and 50 per cent of the September bolls would be destroyed or rendered practically valueless by the insect. Of course the bolls not attacked would develop but the loss would undoubtedly amount to at least as much as 50 per cent of the crop which would develop if the insect were not present.

In the Hawaiian Islands the pink bollworm has prevented the development of the cotton industry which at one time showed considerable promise.

Description and Life History of the Pink Bollworm

The moth resembles somewhat the common clothes moth of this country. From tip to tip of the extended wings it measures from 3-5 to 4-5 of an inch. It is of a dark brown color, the fore-wings ending in a rather sharp point. The eggs are very small objects, somewhat oval, about 1 mm. long and 5-10 mm. broad. The surface is white and finely wrinkled. The larva when first hatched is glassy white with light brown anterior markings. It grows rapidly and when mature measures nearly a half inch in length. It is cylindrical, white, with the dorsal side strongly colored with pink.

Fig. 81. — Pink bollworm on divided wall in cotton boll, showing opening it makes in going from one lock to the next. (Original.)

The pupa is about 2-5 of an inch in length, reddish brown in color, the posterior end pointed and ending in a hook-like process.

There are several insects found in the bolls of cotton in the United States which may be mistaken for the pink bollworm. One of these is the so called pink corn worm which frequently is found in decaying bolls, especially those which have been injured by disease. It has not been known to attack healthy bolls. It does not normally make its way into the seed

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and this habit will help in distinguishing it from the pink bollworm. Another insect which may be mistaken for the pink bollworm is the common bollworm of cotton, *Heliothis obsoleta.* This is the same insect as feeds on corn and is known in some parts of the country as the corn ear worm. It bores holes through the carpels of the bolls, feeds for a short time, and then proceeds to another boll. In the early stages it sometimes assumes a somewhat pinkish color. It may be distinguished from the pink bollworm by its habits, especially by the fact that it does not feed altogether in the interior of the bolls and that it is not found within the seeds. When full grown it is much larger than the pink bollworm, measuring about 2 inches in length when it is fully developed.

Although these descriptions may help in enabling any one to determine whether the pink bollworm is present in a cotton field, it will always be best to send any specimens to an entomologist without delay for authoritative determination. It is extremely important that any possible infestation by this insect be brought to attention at the earliest possible date that prompt eradicative measures be taken.

The eggs are laid singly or in small groups on the green bolls or in the flowers. Generally the eggs are to be found near the points of the green bolls in the sutures marking the locks. As many as four eggs may be found in this situation and altogether as many as twenty eggs have been found on a single boll. It is estimated that a female will deposit in the neighborhood of 100 eggs. These hatch in from four to twelve days.

The larva immediately on hatching bores its way into the boll. The infested bolls sometimes become recognizable by a reddish or blackened discoloration which follows attack. But Mr. Busck finds that the only conclusive evidence of infestation is the finding of the eggshell at the entrance hole or the larva itself within the boll.

The food of the larvae is the seed within the boll. It devours one and generally proceeds to the next above. Ordinarily a single larva does not make its way outside of the lock which it first invades but occasionally the adjoining lock may be entered. It is to be noted that the larva restricts itself to the interior of the boll and never makes its way to the outside for the purpose of reaching another boll. When the larva reaches full growth it often protects itself by webbing two seeds together the attachment being made to openings brought into contact by the insect.

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These "double seeds" are characteristics of the work of the insect. They are generally not destroyed with the process of ginning and furnish the best means of determining quickly whether any lot of seed is infested.

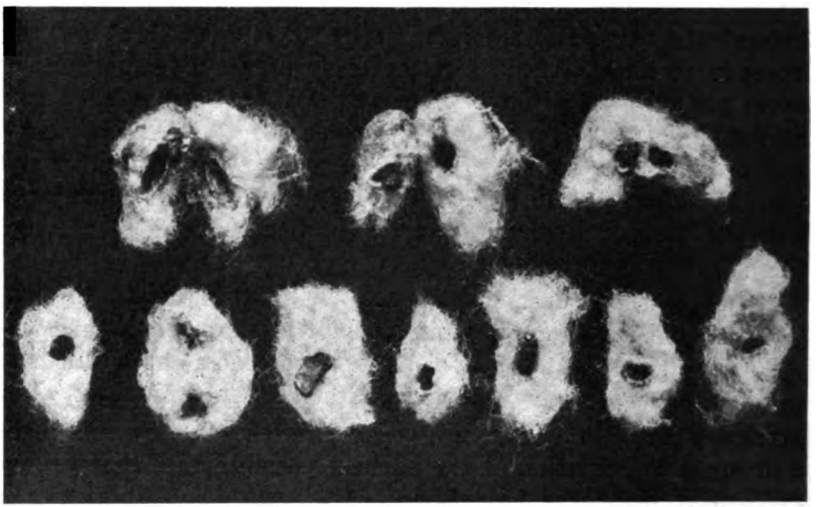

Fig. 82.—Cotton seeds infested by the pink bollworm: above, so-called "twin seeds", being two seeds drawn together by the larva in its last stage. (Original.)

During the summer the larval stage occupies from twenty to thirty days. Later in the season this stage may be more or less indefinitely prolonged. Gough found in Egypt that larvae would remain in a quiescent condition for over two years.

After a variable time, as has been indicated, the larva transforms into a pupa or chrysalis. This stage lasts from ten to twenty days, when the moth emerges. The duration of life of the moth is rather short. Under favorable conditions, Mr. Busck succeeded in keeping some specimens alive for thirty-two days but under the same conditions the great majority of the insects died in fourteen to twenty days.

The moth is very seldom seen in nature. Its habit is to hide during the day under stones or brush. The normal time of flight is from 6:30 to 8 p. m. Although apparently capable of prolonged flight, they prefer to go no further than the first cotton field.

As far as known the pink bollworm has no food plants other than cotton. Statements in the literature on the subject that the species feeds on various other plants are probably due to

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mistaken identification. Among these statements are ones to the effect that the insect has been found on hibiscus in India and pomegranate in Egypt, and on milo in Hawaii. In any case the latter record is erroneous as Mr. Busck was unable to find the insect on milo or induce it to feed on that plant after numerous and persistent efforts. In the Hawaiian Islands there is a wild hibiscus of somewhat common occurrence. It is attacked by a relative of the pink bollworm but this insect is not found upon it, either in natural conditions or when confined in cages.

As far as observed, the insect has no preference for cultivated varieties of cotton. The perennial or Caravonica, Chinese, Sea Island, and American Upland varieties growing in Hawaii are attacked to the same extent. Similar observations have been made in Egypt and India.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING MARCH 31, 1918

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending March 31st, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING MARCH 31, 1918

Citrus grove trees inspected	3,645,187
Citrus nursery trees inspected	12,943,751
Inspectors employed	246
New properties showing infection	0
Total properties showing active infection	2
Grove trees found infected	2
Nursery trees found infected	0
Counties in which active infections were found	2

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,710
Nursery trees found infected since May, 1914	342,254
Number properties infected to March 31, 1918	477
Properties declared no longer "danger centers"	419
Properties still classed as "infected" March 31, 1918	58

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1918:

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1914	1915	1916	1917	1918
	Jan. 306	Jan. 86	Jan. 14	Jan. 0
	Feb. 165	Feb. 21	Feb. 4	Feb. 1
	Mar. 444	Mar. 49	Mar. 9	Mar. 1
	Apr. 408	Apr. 49	Apr. 169	
May 108	May 1042	May 338	May 52	
June 160	June 772	June 450	June 45	
July 275	July 651	July 349	July 39	
Aug. 1313	Aug. 1345	Aug. 219	Aug. 30	
Sept. 767	Sept. 618	Sept. 124	Sept. 6	
Oct. 565	Oct. 214	Oct. 451	Oct. 2	
Nov. 773	Nov. 494	Nov. 131	Nov. 1	
Dec. 366	Dec. 256	Dec. 27	Dec. 1	

DEPARTMENT OF PORT AND RAILWAY INSPECTION

Report for the Quarter Ending March 31, 1918

The following report on the inspections of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector.

Two interceptions worthy of special mention have been made during this quarter. On Jan. 2, 1918, Deputy Port and Railway Inspector Emil L. Gehry intercepted at Key West a branch of grapefruit which was infested with the Spiny citrus whitefly *(Aleurocanthus woglumi)*, commonly known as the "Black fly" or "Mosca Prieta", being brought into this country by a passenger from Cuba. On Feb. 16, 1918, Deputy Port and Railway Inspectors G. B. Merrill, U. C. Zeluff and Troy Thompson confiscated a supply of sweet potatoes on a schooner at Eastport, Fla., which had been brought from St. Lucie, British West Indies, and which was infested by the Sweet potato scarabee *(Euscepes batatae)*.

Ships and Vessels Inspected:

From foreign ports	507	
From U. S. ports other than Florida	317	
From Florida ports	382	
Total		1206

Shipments Inspected:

Arriving by water:

Passed	63	
Treated and passed	7	
Returned to shipper	31	
Detained, subject to return by shipper	3	
Contraband destroyed	244	
		348

Arriving by land—Express, Freight, Wagons, etc.:

Passed	335	
Treated and passed	17½	
Returned to shipper	57	
Detained, subject to return by shipper	81	
Contraband destroyed	19½	
		510
Total shipments inspected		858

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Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of Parcels infested
Citrus scab	Citrus	Spain	1
Cloudy-winged whitefly	Citrus	Cuba	1
Camphor thrips	Camphor	Florida	1
Cherry scale	Peach	So. Carolina	1
Crown gall	Apple	Georgia	1
Crown gall	Peach	Georgia	1
Crown gall	Peach	So. Carolina	1
Dictyospermum scale	Mango	Florida	1
Florida red scale	Citrus	Cuba	1
Florida wax-scale	Ivy	Georgia	1
Greedy scale	Privit	Alabama	1
Ivy scale	Ivy	Georgia	1
Latania scale	Peca n.	Georgia	1
Latania scale	Sapodilla	Florida	1
Latania scale	Unknown plant	Cuba	1
Long scale	Citrus	Florida	1
Lesser snow-scale	Mango	Florida	1
Nematode root-knot	Fig	Florida	3
Nematode root-knot	Fig	Georgia	5
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Peach	So. Carolina	1
Oleander scale	Palm	Cuba	1
Oyster-shell scale	Willow	New York	1
Purple scale	Citrus	Cuba	1
Purple scale	Citrus	Florida	2
Purple scale	Mango	Florida	1
Rose scale	Rose	Mississippi	1
San Jose scale	Apple	Georgia	1
San Jose scale	Apple	New York	1
San Jose scale	Cherry	New York	1
San Jose scale	Lilac	Origin unknown	1
San Jose scale	Peach	Alabama	1
San Jose scale	Peach	Georgia	2
San Jose scale	Peach	Ohio	1
San Jose scale	Peach	So. Carolina	2
San Jose scale	Peach	Tennessee	1
San Jose scale	Pear	Georgia	3
San Jose scale	Pear	So. Carolina	1
San Jose scale	Persimmon	Georgia	1
San Jose scale	Plum	Florida	1
San Jose scale	Plum	Georgia	3
San Jose scale	Plum	No. Carolina	1
San Jose scale	Plum	So. Carolina	1
San Jose scale	Rose	Florida	1
San Jose scale	Rose	Georgia	1
Soft brown scale	Ivy	Georgia	1
Spiny citrus whitefly	Citrus	Cuba	1
Sweet potato scarabee	Sweet potato	St. Lucie, B. W. I.	1
Sweet potato weevil	Sweet potato	Cuba	1
Walnut scale	Grape	New York	1
Walnut scale	Peach	New York	2
Walnut scale	Pear	New York	1
Walnut scale	Plum	New York	2
Walnut scale	Plum	Georgia	1
Whitefly	Citrus	Florida	2
Whitefly	Jasmine	Georgia	1
Whitefly	Privit	So. Carolina	1
Withertip	Citrus	Florida	1

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PARCEL POST PLANT INSPECTION

QUARTER ENDING MARCH 31, 1918

PARCELS INSPECTED:

Passed	2179
Treated and passed	110
Returned to sender	1
Detained, subject to return by sender	11
Infested or infected parcels destroyed	5
Total parcels inspected	2306

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or disease	Occurring on	From	Number of Parcels infested
Crown gall	Peach	Georgia	1
Crown gall	Rose	Illinois	1
Crown gall	Rose	Ohio	10
Florida wax-scale	Ivy	New York	1
Ivy scale	Ivy	New York	1
Mealy-bug	Coleus	Ohio	1
Mealy-bug	Hibiscus	Ohio	1
Mealy-bug	Rose	Ohio	1
Mealy-bug	Salvia	Ohio	1
Nematode root-knot	Begonia	Ohio	6
Nematode root-knot	Chrysanthemum	Ohio	3
Nematode root-knot	Coleus	Ohio	1
Nematode root-knot	Fig	Florida	2
Nematode root-knot	Geranium	Ohio	26
Nematode root-knot	Grape	Florida	1
Nematode root-knot	Hibiscus	Ohio	4
Nematode root-knot	Kudzu vine	Ohio	1
Nematode root-knot	Rose	Florida	1
Nematode root-knot	Rose	Ohio	57
Nematode root-knot	Peach	Florida	1
Nematode root-knot	Petunia	Ohio	1
Nematode root-knot	Plum	Florida	1
Nematode root-knot	Tomato	Florida	1
Nematode root-knot	Unknown shrub	So. Carolina	1
Nematode root-knot	Verbena	Ohio	2
Oleander scale	Oleander	Ohio	1
Oyster-shell scale	Willow	New York	1
San Jose scale	Plum	Florida	1
San Jose scale	Rose	So. Carolina	1
Soft brown scale	Ivy	New York	1
Whitefly	Citrus	Florida	1
Whitefly	Jasmine	Florida	1

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THE ROLL OF HONOR

The following employees of the State Plant Board of Florida are serving in the several branches of the military service:

Ball, Jos. H.	Aviation Section
Barcus, Geo. D.	Aviation Section
Bibby, F. F.	U. S. N. R. F.
Bradford, Horace	Federalized Nat'l Guard
Branam, Jas. R.	Navy
Brown, A. C.	National Army
Brown, Luther	Naval Reserve
Butts, J. L.	Ambulance Corps
Calcote, W. H.	Officers Reserve
Cary, Chas. L.	National Army
Chandler, L. L.	Navy
Dickey, Ed. K.	Officers Reserve
Fletcher, J. M.	Aviation Section
Fogg, Harry W.	National Army
Goldsby, Jack	Ambulance Corps
Green, Guilford	Federalized Nat'l Guard
Grimes, D. W.	Aviation Section
Hansen, H. W. A.	National Army
Harrison, C. J.	Aviation Section
Hood, Richard Van	Lieut., Marine Corps
Howell, John F.	Officers Reserve
Hunt, Chas. M.	Medical Corps
Jackson, Henry C.	Officers Reserve
Lovett, J. C.	Ambulance Corps
Little, Floyd L.	Aviation Section
McClannahan, Howard	U. S. N. R. F.
Maloney, Clarence B.	"Somewhere in Europe"
Miller, Herbert L.	Aviation Section
Moore, Jos. W.	Naval Reserve
Moore, Jules B.	"Somewhere in France"
Neal, Cecil G.	Officers Reserve
Niedernhoefer, Wm. F.	Aviation Section
Roberts, Samuel F.	Navy
Smith, J. G.	National Army
Stephens, Chas. S.	National Army
Swann, Porter R.	Sergt. Cavalry
Walker, Geo. S.	Aviation Section
Wilson, Guy H.	Lieut., Field Artillery

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

ASSOCIATE EDITORS.

E. W. BERGER.....*Entomologist*
F. M. O'BYRNE.....*Nursery Inspector*
FRANK STIRLING.....*General Inspector*
J. H. MONTGOMERY.....*General Grove Supervisor*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

RELATION OF THE STATE PLANT BOARD TO THE WAR.—As the world famine in food becomes increasingly more serious it becomes more and more apparent that the United States, whose economic position is now stronger than that of any of the other belligerents, and after the war will be still stronger by comparison, must at this time consider the future. America has the task of supplying food and raw materials, not only for its own use but for the use of its allies. The agricultural and horticultural interests of Great Britain, France, and Italy are, if not paralyzed, seriously impaired and this condition will continue throughout the period of the war. When peace does come it will find a devastated area where the battles have raged and a broken and battered Europe. During the period of recuperation following the close of the war America will still be called upon to furnish food to her allies, and who knows but that it will devolve upon us to help feed our present enemies? It is an open secret that our military, naval and civil authorities are making preparation for a war of long duration.

Whether it is upon the basis of present war conditions, or of conditions subsequent to the war, the importance of the position occupied by and the work being done by the State Plant Board of Florida and kindred bodies in other states cannot too forcibly be brought to the attention of the public. The production of enormous food supplies, greater quantities than have ever been

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produced before, is the task that is set for agricultural and horticultural America. If the functions of such bodies as the State Plant Board are great under normal conditions they are even greater and more important under the abnormal conditions brought about by the world war.

It is in the protection of food crops that the work of the State Plant Board bears its closest relation to the war. Not only is the State Plant Board using all its available energy toward preventing the entry of injurious insects and diseases of food crops into the State, but it is making almost superhuman efforts to eradicate or control many of those that are already within our borders. Although these efforts would be made under any circumstances, the present trying situation makes it more imperative than ever that success attend its efforts.

As illustrating what the work of the State Plant Board means to success in war may be mentioned the following:

Cotton, although not a food crop, is needed in enormous quantities as an essential to both civilian and military requirements. The State Plant Board is by all known means endeavoring to retard the boll weevil in its onward march and to prevent the introduction into this State of a still more injurious insect pest of cotton, the pink bollworm.

The sweet potato is one of the South's greatest sources of food supply. The value of this crop in Florida alone is estimated from four to six million dollars annually, and it is of equal or even greater value in the other southern states. This great source of food supply is threatened with extinction by a little insect known as the sweet potato root weevil. The State Plant Board is endeavoring to prevent further inroads of this pest and thus protect and save an important source of food supply.

The State Plant Board is engaged in a battle royal with one of the most insidious enemies of plant life known, citrus canker, which has for four years been threatening the citrus industry with destruction.

There has been a shortage in the world's production of sugar. In view of this shortage it is not impossible that Florida farmers will increase their cane plantings. The State Plant Board is at this time trying to eradicate an insect which attacks sugar cane and which has been discovered in two localities in the State.

Perhaps one of Florida's greatest assets is the vegetable producing industry and yet this industry is in constant danger, daily and hourly, of being wiped out should the Mediterranean

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fruit fly gain entrance. The only defenses that guard against this invasion are the Federal and State Quarantine regulations, enforced by the inspectors of the State Plant Board, who are on guard day and night at our various ports of entry and railway centers. And so we might go on for pages citing illustrations, one after another, of the importance and significance of the work which the Plant Board is doing. We might mention the possibility of the introduction of the black fly from Cuba, The Bahamas, and other nearby points where it has gained a foothold, and many other pests.

If the work of the Board is important in time of peace, how much more so is it in time of war? We must not think alone of the present but must consider the future. The work being done by the State Plant Board of Florida and by similar bodies in other states is truly one of magnitude and one which is not as a rule appreciated or understood by the public. As we see it, this work is one of patriotism, loyalty and devotion and every loyal Floridian and patriotic American should regard it as a privilege, a right and a duty to aid and support in every way the State Plant Board and its employees in their efforts to protect the horticultural and agricultural interests of the State and Nation.

THE PINK BOLLWORM OF COTTON.—In this issue is published an article on the pink bollworm of cotton, which insect has gained a foothold in Texas. This article was specially prepared by Dr. W. D. Hunter, of the Federal Horticultural Board, who is personally in charge of the work being conducted by the United States Government to eradicate the pest and is now published that growers in the cotton belt may be more fully informed as to the nature of the menace which threatens the South's greatest industry. Readers of this journal are particularly urged to read this splendid presentation of the subject.

As illustrating the seriousness of the situation which confronts the cotton states it may be stated that should the pink bollworm become firmly established in Texas and spread from that state to other states in the cotton belt, the loss would be staggering. Based upon the estimates of damage done by the pink bollworm made by H. A. Ballou* of the Imperial Department of Agriculture for the West Indies, who has made a careful and exhaustive study of the pink bollworm in Egypt, the annual loss which the South would sustain from such an invasion would be in the neighborhood of one hundred million dollars annually.

*Journal of Economic Entomology, XI, No. 2, page 236, April, 1918.

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Ballou found that in Egypt an estimate of a 10% loss was very conservative. Conditions in our southern states are certainly as favorable for the development of the insect as those in Egypt and perhaps would prove to be more so, so that with a twelve-million-bale crop of 20 to 30-cent cotton the probable amount of the monetary loss is easily estimated.

The State Plant Board has established a quarantine against cotton and cotton seed from points west of the Mississippi River in order to prevent the introduction of this pest into our state. Cotton planters are urged to be extraordinarily careful to avoid ordering seed from west of the Mississippi, for no matter how vigilant and careful our inspectors may be, there is always the possibility of a shipment slipping by and this very shipment might be the means of introducing the pink bollworm into this section of the South.—J. H. M.

ORIENTAL PEACH MOTH.—Another dangerous fruit pest, new to the United States, has been discovered. This time it is an insect, the Oriental Peach Moth *(Laspeyresia molesta,* Busk*)*. Its present distribution covers small areas in Virginia, Maryland, District of Columbia, New Jersey, New York City, Long Island, and Stanford, Conn.

Available information indicates that it was introduced into the United States from Japan on flowering cherries, peaches, or other fruits, about 1911 or 1912, or before the Federal Plant Quarantine Act became effective. Its present known hosts are peach, cherry, plum, apricot, quince, pear and apple. The larvae, small caterpillars, severely injure the twigs, and also attack the fruit very much as does the apple-worm, or codling moth.

This pest will become a serious menace to the deciduous fruit industry unless checked or controlled. At the present time the Bureau of Entomology is engaging all available entomologists and sending them into the fruit-growing sections of all states looking for this and other pests. Messrs. C. H. Alden and Harry S. Saidel, of the U. S. Bureau of Entomology, are the entomologists doing the scouting work in the peach orchards of Florida, assisted by the inspectors of the Plant Board.—E. W. B.

SWEET POTATO REGULATIONS.—That the other southern states are awaking to the danger which is threatening the sweet potato industry in the form of the sweet potato root weevil* and are realizing the necessity of protecting the industry from serious

**Cylas formicarius* Fab.

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injury and loss is evidenced by the enactment by the states of Alabama, Louisiana, Georgia and South Carolina of certain regulations and restrictions governing the movement of sweet potato tubers and plants both within and into these states. Each of these states, following the lead of Florida, has made and published through the proper authorities restrictive orders intended to prevent the further introduction and spread of this insect which has proven to be so destructive where it has become established.

On account of these quarantine restrictions Florida growers are cautioned not to undertake to make shipments of sweet potato tubers, plants, vines, cuttings or draws into other states without first ascertaining what the regulations in force are. Otherwise they incur possibility of loss or damage to such shipments from being held up for non-compliance with what are believed to be reasonable and necessary protective measures. Prospective shippers should, for full details as to what these quarantines are, apply to the following as representing their respective states:

Alabama—G. C. Starcher, State Horticulturist, Auburn, Ala.

Georgia—A. C. Lewis, State Entomologist, Atlanta, Ga.

Louisiana—W. E. Anderson, Acting Entomologist, Dept. of Agriculture and Immigration, Baton Rouge, La.

South Carolina—A. F. Conradi, State Entomologist, Clemson College, S. C.

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Vol. II JULY, 1918 No. 4

THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by
STATE PLANT BOARD OF FLORIDA
GAINESVILLE, FLA.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. II JULY, 1918 No. 4

THE ROLL OF HONOR

The following employees of the State Plant Board of Florida are serving in the several branches of the military service as indicated:

Baker, Byrd O.	Quartermaster Corps
Ball, Jos. H.	Aviation Section
Barcus, George D.	Aviation Section
Bass, Clarence A.	U. S. N. R. F.
Bibby, F. F.	Naval Dispensary
Branam, James R.	U. S. N. R. F.
Brown, A. C.	Veterinary Section
Brown, Luther	Naval Hospital Service
Brown, Merle R.	National Army
Butts, John L.	Aviation Section
Bynum, Eli K.	Infantry
Calcote, Wm. H.	National Army
Carothers, A. B.	National Army
Cary, Chas. L.	National Army
Chandler, Luther L.	U. S. N. R. F.
Clark, Virgil I.	U. S. N. R. F.
Dickey, Edward K.	Aviation Section
Dickson, Albert M.	Officers Reserve Corps
*Donaldson, Wilson T.	Aviation Section
*Dukes, Redding A.	National Army
Fish, Robert E.	Aviation Section
Fletcher, J. M.	Aviation Section
Fogg, Harry W.	Engineers Service Battalion
Goldsby, Jack K.	Ambulance Corps
Green, Guilford	National Army
Grimes, D. W.	Aviation Section
Hansen, Hans W. A.	National Army
Harden, John C.	National Army
Harkins, Donald L.	Balloon Corps

*Died in performance of duty.

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Harn, Sam P.	U. S. N. R. F.
Harrison, Cyrus J.	Aviation Section
Henderson, Francis M.	National Army
Holland, Ed. Alton	Ammunition Train
Hood, Richard Van	U. S. Marines
Howell, John F.	Officers Reserve Corps
Hunt, Chas. M.	Medical Corps
Ingram, Otis D.	National Army
Irwin, Harry M.	Mil. Training School, N. A.
Jackson, Henry C.	Officers Reserve
Little, Floyd L.	Aviation Section
Lovett, James C.	Medical Corps
Maloney, Clarence B.	Royal Flying Corps
McClanahan, Howard S.	U. S. N. R. F.
McCullough, James D.	National Army
Milledge, Stanley	National Army
Miller, Herbert L.	Aviation Section
Moore, Joseph W.	U. S. N. R. F.
Moore, Jules B.	National Army
Neal, Cecil G.	Officers Reserve Corps
Niedernhoefer, Wm. F.	Aviation Section
Oliphant, Ross G.	Tank Division
Parker, Frank R.	U. S. N. R. F.
Roberts, Samuel F.	Naval Hospital
Robinson, Tom	Quartermaster Corps
Robinson, Vernon K.	Mil. Training School, N. A.
Scott, Wm. J.	Hospital Corps
Seeds, Harvey W.	National Army
Sherman, Chas. D.	Ambulance Corps
Smith, Clyde	National Army
Smith, Joseph G.	National Army
Smith, Lawrence O.	National Army
Steil, Fred H.	Aviation Section
Stephens, Charlie S.	National Army
Stevenson, Geo. A.	U. S. N. R. F.
Swann, Porter R.	National Army
Thompson, Troy	National Army
Walker, Geo. S.	Aviation Section
Wilson, G. H.	National Army
Wood, Harry E.	U. S. N. R. F.

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THE THEORY AND PRACTICE OF SANITARY PRECAUTIONS IN GROVE AND PACKING HOUSE OPERATIONS

JOHN C. HOLTON
Assistant General Inspector, State Plant Board.

PART 1

THEORY OF SANITARY PRECAUTIONS

During the time the writer has been in Florida, he has become convinced that a considerable amount of improvement can be made in the methods of handling both our citrus groves and citrus fruits, in order that the industry may not only be more thoroughly protected against injurious insects and diseases but also that the crop may reach the market in better condition and consequently bring a better price to the grower. What it is desired to bring to the attention of the reader in this article is the question of more sanitary methods in the handling of grove properties and the handling of the crop. The principle involved is not a new one by any means, but has been recognized by the Citrus Exchange and a number of independent packers, by most of the leading growers of the State, and by the authorities who have given close study to all phases of citrus production. For example, a bulletin upon "The Diseases of Citrus Fruits", under the authorship of Professors P. H. Rolfs, H. S. Fawcett and B. F. Floyd, published by the University of Florida Experiment Station in November, 1911, summarizes as two cardinal principles in reducing citrus fruit diseases, the following points: "Some of these troubles can be overcome only by better grove sanitation and hygiene." "Wherever possible a disease should be prevented rather than allowed to occur." It is doubtful if more eminent authorities on the subject of citrus diseases in Florida than those just quoted could be found.

The employment of sanitary methods has a quadruple bearing upon the industry. They have to do, first, with the improvement of the condition in which Florida citrus fruit reaches the market; second, with preventing the spread of diseases and insects from one grove to another and from one locality to another; third, their effect in facilitating the final eradication of citrus canker from the State; and, finally, protection of the industry against the spread of diseases which may be introduced into the State, accidentally, of course, in future years. We would prefer to discuss these under separate heads.

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1. Many of our readers may have had the same experience as the writer when visiting fruit markets in northern states. Florida citrus fruit can usually be distinguished from all other fruit at a distance of several hundred feet, simply because it does not present a bright, clean appearance, and it is only the man who has found out by experience the excellent quality of what is *inside* of the rind of the Florida fruit who is the habitual buyer. It seems to us that the time is here when systematic effort should be made to improve the appearance of the Florida fruit, thus enabling it the better to hold its own in competition with citrus fruit from other sections of the United States. Insects and diseases are the principal causes of the discolored and unsightly condition of much Florida fruit that is shipped to the North. While it is true that this condition cannot be remedied without bringing about a more satisfactory control of the insects and diseases now in our groves, it is also true that steps should be taken to prevent aggravation of the present condition, which will undoubtedly result if we permit more and more insects and diseases to enter our groves.

There is also the question of decay and loss of fruit in transit. A consignment of fruit free from decay will bring a uniformly higher price than a shipment consisting of sound and decayed fruit together. In other words, loss from decay in transit is not alone loss of the fruit which is decayed, but the general price of the remaining fruit is lowered. The time was when approximately ten per cent of the Florida fruit shipped to the North was lost through decay and molds. Through the educational campaign conducted by the Florida Experiment Station for the past few years and as the result of better picking and packing house methods, particularly more careful handling of the fruit than formerly, this loss has been greatly reduced. On the whole, taking into consideration all shipments and one season with another, it is likely that the loss from these causes is still in the neighborhood of five per cent. Assuming that the normal citrus crop of Florida is 8,000,000 boxes and that the growers receive an average price of $2.00 per box, a loss of five per cent means an annual loss of $800,000.00 on the Florida crop. We have been reliably informed that a number of growers and packers, through the adoption of better methods in handling the crop and in packing it, have succeeded in reducing this percentage of loss to approximately one per cent. That even this small loss can be reduced by still further improvement in the methods of handling

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the crop is practically self-evident. From a purely financial standpoint, therefore, the adoption of more sanitary measures cannot result otherwsie than in increased profits to the grower.

Among the causes for damage and deterioration of fruit in transit may be mentioned several fungus diseases, the most important of which is usually the blue mold. The term "blue mold" is applied to the damage by one or more fungi which are closely related. The distinction between these fungi need not be discussed at the present time, for their action is practically the same and the methods of dealing with them are the same. The spores of these fungi enter the fruit through clipper cuts, wounds or bruises of the rind, or through injuries made by other diseases, and after entering the fruit they increase and multiply, causing decay. The spores of blue mold are quite generally distributed through groves and packing houses, their relative number being very largely dependent upon the measures employed to dispose of moldy fruits and to prevent contamination of clean fruit by moldy fruit. In experiments made by the Florida Experiment Station several years ago, the great importance of preventing injuries through which these fungi could enter the fruit was clearly established, and as a result of those experiments much better methods of handling the fruit to protect it from injury have come into vogue generally throughout the State. If the fruit could be handled from the tree to the market without clipper cuts, injuries or bruises, there would be no loss due to blue mold, for there would be no way in which the blue mold fungus could gain access to the interior of the sound fruit. Care in handling is therefore of the utmost importance, but one hundred per cent efficiency in this regard cannot be secured. Therefore, if this care to avoid injury to the fruit be supplemented by thorough cleanliness in the packing house and by the use of disinfectants to destroy fungus spores in field boxes, washing tanks and packing houses, a still greater reduction of loss from this source will inevitably follow. As illustrating this, we may cite the case of one packing house in which the loss from blue mold of fruit enroute to market averaged from two to five per cent. Measures of cleanliness in the packing house were adopted, field boxes were scrubbed once a week with soap and water and at the same time more care was employed in the handling of the fruit between the grove and the packing house. The result was that the loss from blue mold was reduced to one per cent. This reduction was brought about

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purely by cleanliness and without the use of disinfectants. How much more then would the loss have been reduced, perhaps to a point inappreciable, had disinfectants been used along with the cleansing work to destroy the blue mold spores?

In a recent conference with Professor P. H. Rolfs, Director of the Florida Experiment Station, regarding this matter, Professor Rolfs expressed the opinion that in reducing the loss from blue mold, dipping of field boxes in a disinfecting solution would be of the first importance, cleanliness of second importance and care in handling the fruit, third. However, all of these matters go hand in hand and a combination of them should practically eliminate losses from blue mold. In fact, Professor Rolfs has stated that careful handling and absence of clipper cuts, coupled with sanitary disinfecting measures and cleanliness, should reduce the average loss by blue mold to less than one per cent.

Another cause of the decay in citrus fruits enroute to market is the stem-end rot, which is caused by the same fungus that produces melanose on the leaves. The form of the fungus which grows in dead wood produces spores which are responsible for stem-end rot and also for the melanose form of the disease appearing on the leaves. The fungus is not able to penetrate green fruits but does penetrate as the fruit ripens. Owing to the damage to trees by the cold weather during the past two years, melanose is unusually abundant this year, and should weather conditions be favorable to its development during the picking season, we may this year expect an unusually large amount of stem-end rot. We are not able to recommend measures which are a complete panacea for all troubles to which citrus fruits are heir, and it must be frankly admitted that the dipping of field boxes in disinfecting solutions will probably have no effect in preventing the development of stem-end rot between packing house and market. This is true for the reason that the fruits are in most cases already infected with the disease when they come to the packing house. It is true, however, that in the grove the fungus can enter the stem of the fruit where the latter is removed by the clippers, and the fungus causing stem-end rot can make its way through at least three inches of twig from the clipper cut to the fruit itself. A stronger argument could not be adduced to show the value of keeping the clippers disinfected when removing the fruit from the trees. This is only another application of the sanitary, antiseptic idea.

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Anthracnose to a small extent develops on fruit enroute. The anthracnose spots on the rind sink in if conditions are cool and moist and these spots afford entrance for the blue mold fungus.

Nail-head rust is caused by the same fungus which causes scaly bark, usually in the presence of the withertip fungus. It is doubtful if the nail-head rust markings continue their development in transit, but these nail-head spots afford entrance for the blue mold. It will be noted, therefore, that the entire question, in so far as decay of the fruit is concerned, is a complicated one in which several different diseases take part and that some of these diseases are agencies through which other diseases may accomplish their nefarious work. Aside from those mentioned, which are quite familiar to all citrus growers, it is advisable to take into account other fungi that are present in the State and should be kept in subjugation as much as possible for the reason that they may at some future time become more virulent and hence more destructive than they are now. Such a disease is the Diplodia rot. This fungus is present in Florida in considerable amount but does not apparently cause much fruit rot. Like other plant diseases this disease might increase in virulence and become of first rank among those responsible for these losses.

Aside from the question of thorough cleanliness, we might say that the dipping of field boxes after each lot of fruit is emptied, using a suitable disinfectant for the purpose, prevents contamination from one lot of fruit to another and protects fruit from clean groves when this fruit is hauled in boxes previously used in groves where these diseases are prevalent. Of course disinfecting of the field box is but one step in keeping down these diseases, and it is proper to suggest also the use of some disinfectant in the water used for washing fruit, such, for example, as using one (1) per cent. of bluestone in water for the washing, or adding one-fourth of a pound (¼ lb.) of permanganate of potash to one hundred gallons of the wash water. It would also appear advisable, in the light of our knowledge regarding these molds and decays, to make rather liberal use of a disinfecting solution in sprinkling the packing house floors prior to sweeping. Sprinkling of floors to keep down dust is in common practice, but the use of a disinfecting solution to destroy the fungus spores would be an added benefit. For this purpose could be used formaldehyde, one part of 40% formaldehyde to

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90 parts of water, a 5% solution of carbolic acid, or a 2% solution of bluestone.

2. Field boxes and field equipment are among the most effective agencies for spreading diseases and insects from one grove to another and from one neighborhood to another. Scaly bark, prior to the adoption of the quarantine rules by the Plant Board, was spread to many neighborhoods in Florida, and in many of these cases the evidence available indicates quite conclusively that the introduction was due to the use of ladders that had previously been used in groves infected with scaly bark. Incidentally, has it ever occurred to the reader that the picking ladder is perhaps the most diabolically complete apparatus that could be devised for infecting trees with any fungus or bacterial disease which enters through abrasions of the bark? The field box is a potent agency in spreading scale-insects and white flies of the different species. All scale-insects in their early stages are tiny crawling lice. They can live without food for several hours, and some of them for several days, so when they are placed in a field box with fruit from an infested tree they can remain in that box until the box is emptied and sent to a grove somewhere else. Cottony cushion scale particularly is readily distributed in field boxes. Thus far we have found eighty-seven species or kinds of scale-insects in Florida and of these twenty-nine kinds attack citrus. All of these in one grove would make fruit from that grove absolutely unmarketable, yet all of them are gradually spreading under present methods of handling the groves and crops and ultimately the majority of them will be in each and every grove unless better methods are adopted to prevent their general dissemination. Distribution of both diseases and scale-insects through the agency of field equipment, and particularly ladders, bags and field boxes, can be practically prevented if these things be disinfected at proper intervals.

3. In relation to the eradication of citrus canker, we believe it can safely be said that the turning point towards victory has been reached. In all there have been 478 properties in the State which have been found infected with the disease. The Plant Board has already declared as no longer danger centers 432 of them, or 90%. This declaration by the Board is equivalent to stating that in the opinion of the Board canker has been eradicated from these properties. There are still 46 properties in the State classed as infected, and if we could be sure that there are no infections in the State other than those we have

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discovered and that we have under quarantine, we could almost guarantee that eradication of the disease would be completed within the next two years. However, there may be other infections that we have not discovered. The reader will naturally ask why we have not inspected all of the citrus properties in the State to find out whether they are infected. There are over 10,000,000 citrus trees in the groves of Florida, and to make one inspection of them with the largest force of inspectors we have ever had would require several years' time. The truth of the matter is that it has taken nearly all of our available funds and nearly all of our inspectors to stamp out the infections which have been discovered, and it is only as we make more and more progress in cleaning up these centers of infection that we have any inspectors available to undertake the advance or scout inspection of areas not hitherto inspected.

We also know that we have never been able to secure a complete record of all the citrus trees that were shipped from canker-infected nurseries. Some of the shipments that escaped us, and which we have never been able to locate, may be somewhere in Florida today with citrus canker on them. There are several possible ways in which infection may have become established without our finding out about it. Trees may have been sneaked into the State from infected localities in the baggage of individuals, or in the earlier days infected fruit may have been shipped to different parts of Florida.

The point we wish to impress upon the reader is, that if any such undiscovered infections are in existence, spread of canker is taking place from them almost daily by reason of laborers, teams, fruit buyers and others entering those properties and then going to other properties. Unless we adopt and put into practice everywhere methods which will stop the spread of canker from the undiscovered infection, we do not know how long it will be until we complete the eradication of canker. The only way the grower can protect himself against the undiscovered infection is to so handle his property that citrus canker cannot get into it, no matter from what source or in what way it may come. This means, of course, the employment of sanitary precautions in the handling of his grove property, and the sooner the growers in general adopt these measures the sooner will the eradication of canker be completed and money saved, not only to the fruit grower but to the general taxpayers throughout the State.

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4. Many of our groves are veritable zoological gardens and pathological museums in the variety and number of insect and fungus diseases present therein. It is, nevertheless, a fact that there are many destructive insects and diseases which we do not yet have. If any of these are accidentally introduced in the future despite all of the quarantine work of the State authorities, they will spread just as diseases have spread in the past unless the growers take measures to forestall them. The brown rot fungus is not known to be in Florida, but if it should ever be introduced it would be difficult for the growers to detect its presence because of its close similarity in the gummosis form to bark diseases of citrus which we already have. The disease might easily attain a wide distribution before its dangerous nature is recognized and special steps taken to suppress it. A disease such as this, which may cause a loss of 25% of the fruit enroute to market, is to be guarded against in every way possible.

In Jamaica, Cuba, the Panama Canal Zone, and the Bahamas is an insect known as the spiny citrus white fly, or black fly, closely related to our own white fly but many times more destructive. There is every reason for believing that under Florida conditions it would be as serious a menace as citrus canker. It does not confine itself to citrus trees, however, but is destructive to the mango, guava, sapote, and many other trees. Of course we are trying to keep it out and will continue to try to keep it out to the utmost of our ability and resources, but should it by any chance get into any citrus grove in Florida the field box would, under present conditions, immediately become the means of spreading it from grove to grove and from county to county. The use of sanitary precautions and the disinfection of field equipment is, therefore, good insurance against the wholesale distribution of pests and diseases which threaten us from the outside, and which when they do get into Florida will be in and at work before their presence is discovered.

PART 2

Practice of Sanitary Precautions

On October 8, 1917, the State Plant Board passed its Rule 36 covering the subject of disinfection of field boxes used in public fruit packing houses. This rule was later amended. On June 10, 1918, the Board suspended the operation of Rule 36 for a period of one year. The Board, in taking this latter action, did

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so as a war measure, feeling that with the existing shortage of labor, the use of any large number of men in any horticultural activity which does not directly and immediately result in increased production of food crops is unwise. The application of the instructions issued under the provisions of Rule 36 would require the employment in the packing houses of the State of Florida of perhaps several hundred men, and since the benefits accruing from the disinfection of field boxes can hardly be regarded as immediately and directly influencing food crop production and the services of these several hundred men can be used to greater advantage in other ways, such as in shipbuilding, munition making, planting, cultivating and harvesting food crops, the Board took the action above referred to and suspended the operation of the rule, at the same time reiterating its belief in the efficacy of sanitary precautions in packing house operations as a means of preventing the spread of diseases and insect enemies of fruit trees and urging all packing house operators to make use of the prescribed measures when practicable to do so.

It seems desirable, therefore, at this time and following the action of the Board, to give to the fruit-growing public and to the interested packing house operators, as briefly as possible, the results of the observations made and the experience gained in the actual application of the measures advocated.

The reasons why sanitary precautions should be practiced in field and packing house operations have been set forth so clearly and concisely in the section devoted to the Theory of Sanitary Precautions, that it seems hardly necessary to dwell further on this subject. However, it may be of interest to refer to the conception of the idea which later developed into the present rather complete plan of grove sanitation, and to briefly follow the growth and development of this idea. Like many other things which eventually amount to something, the origin of the plan of using sanitary precautions, that is, precautions by cleanliness to prevent injury to trees and products, goes back to the period when damage to trees was first caused by diseases and pests.

The Evolution of the Idea of Sanitary Precautions

In the earlier history of horticulture, no doubt man attempted to combat the ravages of diseases and pests by crude efforts along the line of prevention. In more recent years, the knowl-

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edge that diseases of trees were often caused by micro-organisms led to the use of methods of treatment looking not only to cure, but prevention. Frequently methods of treatment were used which were effective, and no doubt the method was given credit for curing, whereas the cure was effected by the removal of the diseased part, and the prevention of recurrence and of further spread was the result of the application of the "cure" or "remedy".

The idea of preventive treatment of diseases and pests in orchards has, without much blare of trumpet, kept up with other progressive movements in modern science, and the practical horticulturist has not been slow to accept and use the suggestions made from time to time by those engaged in research work. Here in Florida the citrus fruit grower has for many years been making use of methods in his grove operations which, while not recognized as such, were in reality the rudiments of what is now rather commonly referred to as "sanitary precautions in grove operations". The greatest advance in the direction of grove sanitation has been made during the past few years, and the reason for the progress is without question directly traceable to a calamity—the introduction of citrus canker into Florida. The introduction of this disease which threatened the citrus industry with destruction, and the eradication of which has for four years been the one big thing in the minds of the citrus growers of Florida, was little short of a disaster. The actual money loss incident to the introduction of citrus canker, if it were possible to compute it with any degree of accuracy, would doubtless run into many millions of dollars if we include, in addition to the cost of the eradication campaign and the destruction of trees, the depreciation of property values in many sections of the citrus-producing area. Yet this very disaster has served to bring the growers of Florida into a closer relation with each other, was the cause in great measure of the enactment by the Legislature of an adequate and, in many respects, a model horticultural law, and has resulted in many other benefits to the fruit industry. Not the least of these benefits is the higher development of the idea of grove sanitation and the creation of a healthy sentiment in support of this idea. At the risk of repeating what is perhaps a familiar story to many, it may be well at this time to go somewhat into detail as to the growth and development of the idea of sanitary precautions covering the period of the past several years.

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In the summer of 1914 the citrus growers in South Florida were themselves handling the campaign to eradicate citrus canker, the disease not having been known to exist at that time anywhere in the State except Dade County. There seemed to be very little progress made. It was noted that whenever an infected property was found by inspectors, upon reinspection additional trees were found infected. This happened no matter how carefully the property was inspected the first time. It must be remembered that there was very little known about citrus canker. In fact, at this time there had been no public announcement made that the disease was caused by a micro-organism. However, when the laboratory investigations disclosed the fact that the disease was caused by an organism, this, in connection with the fact that cankered trees had been so frequently found in large numbers on inspections made subsequent to visits by inspectors, led many of the thinking growers to the conclusion that the inspectors and owners were themselves carrying canker. As an evolution of this thought, efforts were made to so disinfect the inspectors as to prevent the carriage of the disease. These efforts were at first very crude indeed, consisting of the use of a small hand spray, such as is used by amateur gardeners, for spraying the inspectors' clothing, especially the lower extremities and shoes, with a solution of bichloride of mercury. With time the idea of the thorough disinfection of inspectors' clothing developed further, and with increased knowledge derived from both field and laboratory investigations it was finally determined that the only proper course to pursue was to treat the inspectors who visited infected as well as non-infected groves very much as though they were surgeons or nurses entering an operating room for the purpose of performing an operation. In other words, when an inspector entered a citrus property he was perfectly clean so far as disinfection of his outer clothing was concerned. This result was obtained by means of his wearing a one-piece suit which had previously been dipped in a solution of bichloride of mercury, a head covering similarly dipped, and leggings and shoes which had been disinfected. The disinfection was even carried to such an extent that the hands, face and neck of the inspector were bathed in the bichloride solution. Inspectors were not allowed to touch the trees when possible to avoid doing so. It is significant to note that, with the adoption of these methods of personal cleanliness, or disinfection, in conjunction with the immediate destruction of trees

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when found to be infected, begins the period when we made some headway against the inroads of citrus canker.

Another evolution of the same idea of disinfection evidenced itself in the restrictions which were placed upon the operations conducted in infected properties. All work done in properties which were found infected with citrus canker was done under certain precautions which were prescribed by representatives of the State Plant Board. Workmen were required to be as particular and as careful in the disinfection of their clothing as were the inspectors themselves and all tools, vehicles and other equipment used in the infected property were thoroughly disinfected. It may be well said that the successful eradication of citrus canker is dependent upon careful inspection, destruction of diseased trees immediately when found, personal disinfection of inspectors and workmen, and the conduct of the work in infected properties in a sanitary manner. Practically all operations in groves and nurseries where infected trees are found are carried on for long periods under such precautionary measures as outlined above, and when an individual, horse, or mule leaves such properties he is thoroughly disinfected.

Disinfection of Field Boxes

Among other measures made use of in the eradication campaign was the requirement that owners of citrus canker infected properties must immerse in an antiseptic solution all field boxes used in picking fruit and also that all public packing house operators in the vicinity of infected properties should follow the same practice. We are confident that this procedure has contributed in a great measure in preventing further distribution of citrus canker. As a material evolution of all of the above practices, that is, of the disinfection of equipment, of individuals and field boxes to prevent the spread of citrus canker, the thought occurred to many of the more progressive growers of the State and to the staff of the State Plant Board, that if such practices were beneficial as applied to citrus canker, why would they not be equally so if applied in an effort to prevent the spread of other diseases caused by organisms? And why not also practice these methods to prevent distribution of injurious insects? This feeling among the more progressive growers of the State has, during the past two years, developed and grown to such an extent that the disinfection of field boxes and other equipment is now strongly advocated and is being practiced

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by many growers and packing house operators. This advocacy primarily of course being for the purpose of preventing the distribution of citrus canker from any undiscovered foci; at the same time it seems now to be a well recognized fact among growers and packing house operators that diseases of various kinds and insect pests affecting fruit trees may, in great measure, be prevented from being distributed if field and packing house equipment are disinfected.

The various agents of the State Plant Board, stationed in different sections of the State, from time to time reported to the Gainesville office the growth of this sentiment. The Plant Commissioner's office was in receipt of many letters from prominent growers in the State advocating the use of sanitary precautions in grove operations, many growers requesting that a rule be passed by the Board which would require the disinfection of field and packing house equipment, more especially such packing house equipment as was used by the public packing houses, the danger in this particular instance being regarded as especially great on account of the wide distribution which field boxes used in public packing houses usually attained. After a thorough canvass of the situation it seemed advisable to the Executive Staff of the Plant Commissioner's office to recommend to the Plant Board the adoption of a rule covering this subject and the Plant Board, after very careful consideration of the information submitted to it, acceded to what appeared to be a very strong demand on the part of the growers of the State and enacted Rule 36.

Application of Sanitary Measures in Packing House Operations

Under the provisions of Rule 36 the Plant Commissioner issued certain instructions requiring that all public packing houses engaged in packing citrus fruit install suitable dipping vats or other apparatus for the purpose of disinfecting, by immersion in a disinfecting solution, each and every field box in which fruit is brought to such packing house. The Plant Commissioner also prescribed certain disinfecting solutions, the chief of which was a solution of bichloride of mercury at a strength of 1 to 1000.

As previously mentioned, Rule 36 was formulated and passed by the Board in response to a general demand on the part of the growers of the State for some action along this line, and as

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a result of observations made throughout the State by the Plant Commissioner and his assistants as to the practical operation of certain precautionary measures in use in communities where citrus canker has been prevalent and which measures were instituted for the purpose of preventing the possible distribution of this particular disease.

Since the passage of Rule 36 this office has received many commendatory expressions and assurances of earnest cooperation from growers and packers in various parts of the citrus belt. The consensus of opinion among growers seems to be that in the passage of this rule the Plant Board made a very long stride indeed in the direction of further protecting the citrus industry.

In some quarters the impression has prevailed that the disinfection of field boxes involved the use of complicated apparatus and machinery, the use of considerable extra labor and the incurring of quite an additional expense to the packing house operators. This impression is wrong. It was and is suggested that packers confine their installations to as simple and inexpensive apparatus as possible for the present. As a result of the experience obtained during the first season of operation, the operator will be in better position to determine his requirements and the nature of the outfit best adapted to his use. No doubt the use of conveyors, belting, diverters and other apparatus will ultimately prove advantageous. Perhaps some packing house operators will even at this time know their needs to such an extent that they can at once extend their equipment to meet the new demands, thus being able to more efficiently and economically handle the dipping of field boxes. It must be remembered, however, that the arrangement of packing houses is by no means uniform. It is impossible for the Plant Commissioner's office to give advice or information which would apply to all packing houses as to the arrangement of any equipment which the instructions in regard to the disinfection of field boxes may require. The problems in connection therewith must of necessity be solved in accordance with the arrangement of the present packing house equipment.

The simplest device suggested for the disinfection of field boxes consists of a cypress vat or tank 7½ feet long, 3 feet wide and 2½ feet deep, located close to the place where fruit is received and dumped, with a drain board of the same width as the vat placed at one end of the vat and slightly inclined so that

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the excess solution may drain back into the tank after the field boxes are dipped and placed on the drain board. When possible, this vat or tank is located at the side of the dump so that the man operating the dump can also immerse the field box, which in many instances eliminates the services of an extra laborer. As has been found by experience, the truck man hauling in filled boxes to the dump man can at the same time remove the empties on his return trip. The Plant Commissioner, in a letter of instructions addressed to all packing house operators of the State last season, made the above suggestion and it apparently met with the approval of a large per cent of the operators. The size and shape of the dipping vat is of minor importance. The wooden vat seems to be preferable to the metal vat and is more generally used. Among the more recent improvements made on dipping vats is an outfit devised by the manager of the Winter Haven Citrus Growers' Association, which consists of a box made of wood mounted on low wheels so that it can be moved from one place to another in the packing house. One concern manufacturing packing house equipment has constructed a mechanical device for the disinfection of field boxes. This was used in several packing houses last season with apparently good results. There are many operators in the State who have given much study to this subject, and doubtless in the near future the packers of the State will be offered a device more economical and practical than anything yet devised.

Cost, etc., of Disinfecting Field Boxes

As the packing season of 1917 and 1918 was drawing to a close, after Rule 36 had been in operation for some time, it was decided by the Plant Commissioner and his assistants to procure first-hand information from the packing house operators themselves in order to ascertain how the practical application of the instructions issued under Rule 36 was working. To accomplish this object, representatives of the Plant Board called upon the packing house operators in their respective districts and presented a series of questions pertaining to the season's operations. There are on file in the office at Gainesville the names of 414 individuals, firms or corporations listed as operators of packing houses in the State. We have received definite reports from 166 of these packing houses. Of the 414 packing houses listed, approximately 200 operated during the season of 1917 and 1918. Many of the packing houses were not operated

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last season, as the fruit crop was greatly reduced in some sections as a result of the cold spells of 1917 and 1918. The results as tabulated from the 166 reports received are very gratifying. These reports were from packing houses operating in 18 of the 24 citrus producing counties of the State. As stated, 166 packing houses made reports. Of those reporting, 81, or practically 50%, complied fully with the instructions issued under Rule 36. The vast majority of the operators from whom reports were received endorsed the idea of sanitary precautions in packing operations. Sixteen operators expressed disapproval. Others were non-committal. We note further that 24 operators who had not previously done so signified their intention to install dipping vats before the opening of the packing season of 1918-1919.

A few packing house operators have advanced two objections which are worthy of note, namely, that of cost and of supposed damage to the field boxes by reason of dipping them in the disinfectant. The matter of cost must of course be given due consideration, although experience has shown that the cost of operating under sanitary precautions is so little as to be hardly worth considering. The figures given in this article are authentic, having been obtained from packing houses that actually installed dipping vats and disinfected field boxes last season. One of the most striking reports that has been called to our attention comes from Mr. J. B. Booth, manager of the Tavares Exchange packing house, which packing house made use of sanitary precautions in their entirety throughout the season of 1916-17, as well as the season of 1917-18. It has been found that the added cost of immersing field boxes in bichloride solution in the Tavares house is ¼ cent per packed box and the total cost covering disinfection of all field equipment, including boxes, bags, ladders, clippers and the one-piece suits worn by pickers is about 2/3 of a cent per box. From the reports sent in by the District Inspectors of the Plant Board, after calling on the packing house operators in person, we find that of the 49 operators who made reports as to the cost of dipping field boxes last season, 37 report the cost as not exceeding $5.00 per 1000 boxes or ½ cent per box or less. The total cost of dipping field boxes ranges from $12.50 per 1000 to $1.60 per 1000 boxes. The lowest figures submitted were received from Mr. D. H. Duggins, manager of the Ozona Citrus Growers' Association, where a mechanical device was used to disinifect the field boxes. There

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are other packing house operators, though, who have also reduced the cost to a very low figure. The report of Mr. F. B. Rainey, manager of the Ft. Green packing house, shows the remarkably low cost of $2.00 per 1000, or 1/5 cent per box. Mr. L. B. Skinner of Dunedin, Florida, reports that the total cost of disinfecting field boxes last season in his packing house was $2.35 per 1000 boxes, or a trifle more than 1/5 cent per box. A general average of cost based on the forty-nine reports filed by the packing house operators, previously referred to in this article, representing nearly every citrus growing county in the State, is $5.00 per 1000 or ½ cent per box. These figures come from all kinds of packing houses ranging from the smallest to the largest, with no uniformity as to size, shape or equipment. It is interesting to note that the lowest figures submitted come from operators who have installed some mechanical device. Most operators dipped by hand and the cost was in every case greater, using the same disinfectant, than where a mechanical device was used. A number of operators when called upon to furnish an estimate of the cost of disinfection replied that the cost was too small to be accurately estimated. We think that it is a safe conclusion that the cost of using *all* sanitary measures advocated in packing and handling citrus fruits will not exceed one cent per box of packed fruit.

Deterioration of Equipment

There is practically no deterioration of the metal parts of the boxes on account of dipping in a bichloride solution. Our observation has been that field boxes which were repeatedly dipped at packing houses over the State last season show that the boxes are in no worse condition on the average than similar boxes which were not dipped. For the purpose of determining the effect of the corrosive sublimate solution (1 part to 1000) used in dipping boxes, several experiments were conducted here in the office at Gainesville. Metal stripping dipped in the solution every third day for three months, and both stripping and cement nails dipped four times daily for three weeks were discolored but showed no marked corrosion. In neither of the above tests was any appreciable injury noticeable. In fact, several months after the above experiments were conducted, the same pieces of metal that were used previously are now being dipped as before and hung in the open where the sun and

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air can gain access to the metal, and still show no appreciable injury.

The conclusion is that both from experience in the packing house and the office tests the deterioration is so slight that it is hardly worth considering.

Disinfecting Solution

As to the solution best adapted to the disinfection of field boxes and field equipment nothing better has so far been found than bichloride of mercury, of a strength of 1-1000. This strength is obtained by the addition of eighty grains of commercial bichloride to each gallon of water, or one pound to ninety-eight gallons of water. This is the solution advocated by the Plant Commissioner and is in general use throughout the State. Other solutions have been used but bichloride of mercury is the best. Even though bichloride of mercury is an efficient germicide, one of the strongest known, and its use will most certainly destroy disease germs and prevent distribution of diseases, yet it must be admitted that it is not a very strong insecticide. In fact there is not known at this time any single chemical or substance or combination which possesses equal value as an insecticide and germicide and which would be suitable for disinfecting packing house equipment. For the time being it seems that bichloride of mercury is the best material that can be made use of for disinfecting field and packing house equipment.

State and Federal authorities are now, and have been, working to find a solution to this problem, that is, to find a combination of chemicals which will combine insecticidal and germicidal properties to such a degree as to insure the destruction of disease-causing organisms and also of mature and immature injurious insects. Such a combination to be of practical value must be one which will be cheap, easily obtained and used, harmless to boxes and other equipment as well as to the hands of the users. Considerable progress has been made in this work. It is hoped that in a comparatively short time announcement can be made of the results of these investigations.

It may be of interest to readers of this article to know that with the advancement of the idea of sanitary precautions in grove operations horticulturists of other states have become very much interested in the progress being made in Florida along these lines and it will not be surprising if, after it has been fully demonstrated that the use of these precautions is a

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practicable thing, other states and other communities will adopt their use. The Federal Government is working in very close cooperation with the State of Florida along these lines, and is watching with the closest attention the progress that is being made and the results obtained.

SOME IMPORTANT DISEASES OF SWEET POTATO*

By C. D. SHERBAKOFF
Associate Plant Pathologist, Florida Agricultural Experiment Station.

Sweet potatoes are of great importance in the agriculture of Florida, even at the present time. The crop is well adapted to the State's soil and climate and therefore should occupy an even more important position on our farms. In fact the profit from this crop could hardly be excelled by any other crop here if it were not for the different diseases to which this crop is commonly subject. Some of the diseases injure the plants in the field and thus reduce the yield; others attack sweet potatoes in storage and in that way further reduce the results of the harvest.

Both field and storage diseases are of about equally great importance to an individual grower and thereby to the State and country at large, yet most of the purely storage troubles affect directly only the grower without immediately threatening the industry or the community in which the grower extends his activities. When a soft rot destroys his sweet potatoes in the pit or storage house, the potatoes are lost. An entirely different thing takes place when sweet potatoes become affected with one of the important field troubles such as wilt or black-rot or foot-rot. In that case the disease not only causes more or less severe loss to the grower whose potato plants become affected with it, but his land, plants and seed will also be contaminated with the disease. Through their medium the trouble will be widely spread to every farm and garden into which will be brought such soil, plants or seed. The importance of this fact can be easily realized by any open-minded person when these two points are considered: (1) that under conditions favorable to any of these diseases practically every draw in a bed may become affected with one or all of them; and (2) that the effect, during an early stage of the disease, is often not very noticeable and thus the plants are regarded as being healthy. These diseased plants

*Principal information in regard to the diseases discussed in this article are taken mainly from Farmers' Bulletin 714 on "Sweet-potato Diseases," by L. L. Harter.

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may, as it actually happens, be in hundreds of shipments sent out to farmers all over the State and thus these troubles are widely spread and jeopardize the industry.

Sweet potato growers, especially those who deal in sweet potato plants, should plainly understand at least this much: the disease, if not taken care of, will sooner or later get into their sweet potato beds and fields and thus directly cause to the growers considerable loss year after year and then eventually will ruin their reputation as sweet potato plant and seed producers. Another thing that should be considered in this connection is that all these important field diseases of the crop are, as it will be seen later in this article, comparatively easy to control and therefore no one really has any excuse for having them except an excuse based on either plain ignorance of the diseases and their control or on a manifest negligence of his plain duty to himself and to the community in and from which he makes his living.

Sweet potato diseases have been for quite a while under careful study by plant pathologists of some states, such as of Maryland, New Jersey and Virginia Experiment Stations and of the Bureau of Plant Industry, Department of Agriculture, Washington, D. C., and are at present well known in all their essential features, namely in their appearance, behavior and control. Any one looking for detailed information on these diseases may do well to obtain from these institutions bulletins on the subject. In fact, the writer believes that every sweet potato grower should have at least Farmers' Bulletin No. 714, which treats nearly all known sweet potato diseases and which may be obtained on request from the Bureau of Plant Industry, Washington, D. C.*

L. L. Harter in the Farmers' Bulletin just referred to, divides all sweet potato diseases into three groups. Field troubles attacking stems and underground parts of the plants, field troubles attacking sweet potato leaves, and storage rots.

Leaf Diseases

Of the diseases affecting the leaves, on which they produce certain spots, at present none is known to be of sufficient importance to warrant special measures of control. Leaf-blight caused by

*In that bulletin the care of sweet potato beds is discussed mainly from the point of view of conditions prevailing in middle Atlantic and Western states, where hot beds or at least cold frames are necessary for a sufficiently early production of the plants. The Florida grower fortunately does not need them and thus his difficulties in this connection are practically none.

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the fungus *Phyllosticta batatas,* Leaf-spot caused by the fungus *Septoria bataticola,* and White-rust caused by the fungus *Albugo ipomoeae-panduranae,* are of common occurrence in nearly every sweet potato growing district. Because of their relative unimportance they will not be discussed here.

Storage Rots

usually destroy the greater part of sweet potatoes left in storage for winter and spring markets. There is no question that many more potatoes would be grown in this country if not for these rots which, under ordinary conditions, make the grower sell his potatoes too early in the season to realize the best price. This is so because under the conditions of almost absolute lack of measures to protect sweet potatoes against these rots it usually is safer and more profitable to sell all potatoes soon after harvest even at a very low price, than to store them and in consequence lose most of them during the storage and then sell what is left at a high price.

The following are well known storage rots of sweet potatoes: Soft-rot and Ring-rot, both caused by the common bread mold, *Rhizopus nigricans;* Black-rot, caused by the fungus *Sphaeronema fimbriatum;* Dry-rot, caused by the fungus *Diaporthe batatatis;* Java black-rot, caused by the fungus *Diplodia tubericola,* and Charcoal-rot, caused by the fungus *Sclerotium bataticola.* Of these rots, soft-rot and black-rot are most common.

Soft Rot, as the name implies, produces a soft decay of potatoes. It starts at either end of the potato and in the presence of high humidity and at high temperature completely destroys it in a few days; such decayed potatoes while soft and watery at first, soon lose their moisture and become hard and brittle. If the potato skin be broken while the rotted potato is still in the soft stage then on the potato surface the fungus which causes this rot will produce its luxuriant moldy growth with a great mass of its spores. The mold is very common everywhere, grows readily on many decaying substances and is present in dust and on dirty boards, crates and so on. The rot gets into the potato through the ends where it was detached from the mother plant and through other injuries on its surface. The trouble is greatly favored by an abundance of moisture in and around the potatoes and by high temperature. Therefore to protect potatoes against this rot one should properly handle them from digging time to the end of the storage period. One should keep in mind that during digging and subsequent hand-

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ling until placed in the storage, potatoes ought to be as little injured as possible; that in the field after digging and during the first two weeks of the storage they should be thoroughly cured, and that after that the temperature of the storage house should be comparatively very low.

To control soft-rot observe the following suggestions:

1. Dig the potatoes during bright, clear weather and allow them to thoroughly dry in the sun, without exposing them though to a too hot, scalding sun.

2. Place the dry dirt-free potatoes in open crates and then place them in the storage house in the crates. In this way the potatoes will have better ventilation, become less bruised than by dumping them into the bin and will be much easier to handle later on.

3. During the first two weeks the temperature of the storage houses should be high, namely from 80° to 85° F., and the house thoroughly ventilated to carry off moisture given off by the potatoes during this period of their curing. Then the temperature should be slowly lowered to from 50° to 55° F. During the remaining period of storage one should now and then examine the humidity of the house and give extra ventilation when necessary.

From the recommendation just given it is evident that for the safe storage of potatoes one should have an adequately built storage house, the temperature and moisture of which can be easily regulated.

There are some good plans available which show how to build a very simple and effective sweet potato storage house. A plan like this may be obtained on application either from the Florida Experiment Station, Gainesville, Florida, or from the Bureau of Plant Industry, Washington, D. C.

Sweet potatoes handled and stored in the way suggested to prevent soft-rot will in a great measure be protected also from other storage rots.

BLACK ROT is the other very important storage rot. It is caused by the same fungus as that which causes an important sweet potato trouble in the field, namely "Black-shank", and is discussed here later on under that disease.

FIELD DISEASES OF STEMS AND ROOTS

There are several field diseases affecting stems and roots of sweet potato plants. Of these, foot-rot, wilt, and black-shank are of great importance with us, and will be now discussed.

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FOOT-ROT OR DIE-OFF. This disease affects sweet potato stems, roots and vines. It may start in the seed bed or in the field. On the stems it appears at first in the form of small brown to black spots which gradually extend, girdling the plants and progressing up the stems several inches; downward the trouble extends

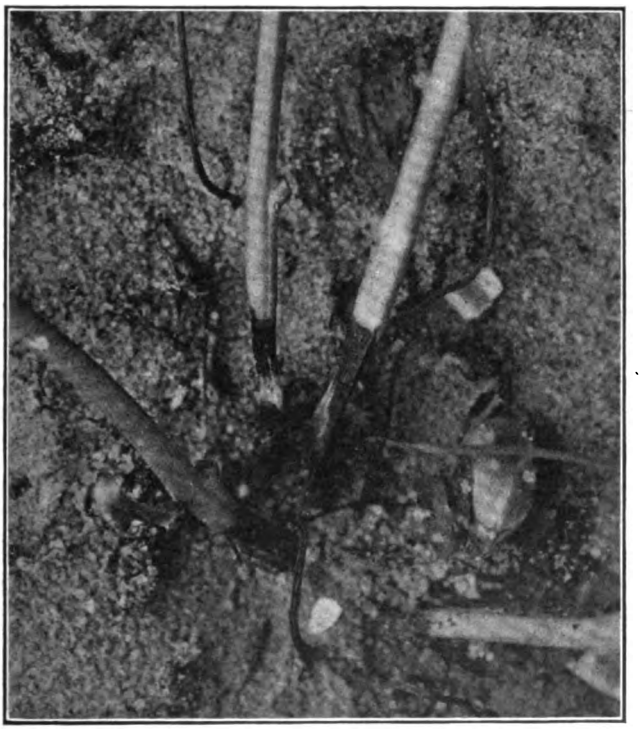

Fig. 83.—Sweet potato stems affected with foot-rot. The stems at their bases show dark brown rot typical for this disease. (After J. A. McClintock, Va. Truck Exp. Station, Bul. 22.)

only a very short distance. The disease progresses somewhat slowly and hence affected plants begin to die off usually only late in the season. A severe case of the attack of this disease on sweet potato stems is shown in Fig. 83. After a time the diseased parts of the stem become covered with numerous, barely visible specks. These are fruiting bodies of the fungus, *Plenodomus destruens,* which causes the disease. The infection may extend down into the roots where it produces a firm brown rot as shown in figure 84. The surface of the rotted roots later on becomes also covered with numerous fruiting bodies of the

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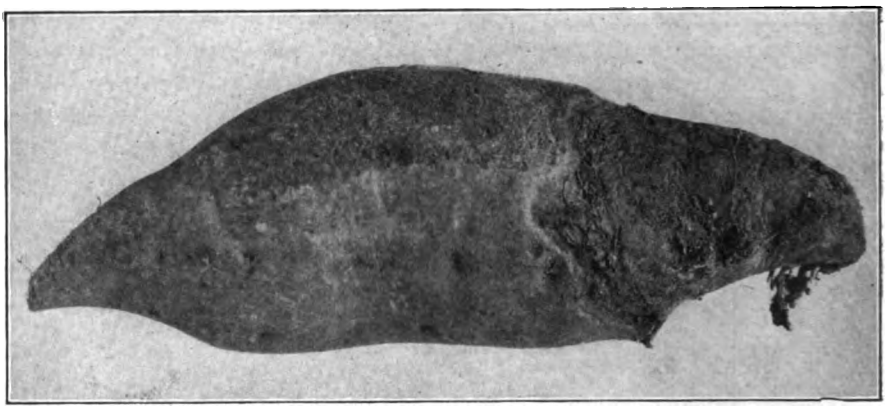

Fig. 84.—Sweet potato rotted at one end by foot-rot fungus. (After J. A. McClintock, Va. Truck Exp. Station, Bul. 22.)

causal fungus which here appear in the form of minute pimple-like structures.

Usually the fungus invades only underground parts of the plant but during a rainy season and with a rank growth of the plants, the vines frequently become also attacked. In this case the rot extends sometimes for a considerable distance each way from the starting point.

Usually no potatoes are produced in the hills attacked with this disease. Foot-rot is known to occur in Florida and in several other states and it seems that the trouble eventually will be found everywhere where sweet potatoes are grown. This will happen, of course, if its further spread is not prevented.

The damage caused by the disease often amounts to more than half of the crop. The disease is distributed through seeds and plants and old vines contaminated with the fungus. The means of distribution of the fungus should be remembered because on this knowledge are based the methods of control.

To control foot-rot. Use only carefully selected seed. No potato showing any sign of rot should be used as seed. Just before bedding the seed potatoes they should be disinfected by soaking them for ten minutes in a solution of corrosive sublimate of 1:1000 strength. To make this solution, dissolve 1 ounce of corrosive sublimate, crystals, in 8 gallons of water. The same solution can be used over again three times, then it should be discarded and a new solution made if more seed needs to be treated. Corrosive sublimate is an extremely strong poison and should be handled in such a way as to insure that neither

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human beings nor farm animals or birds get a drink of the solution. It is not poisonous to the skin and thus hands wet with it

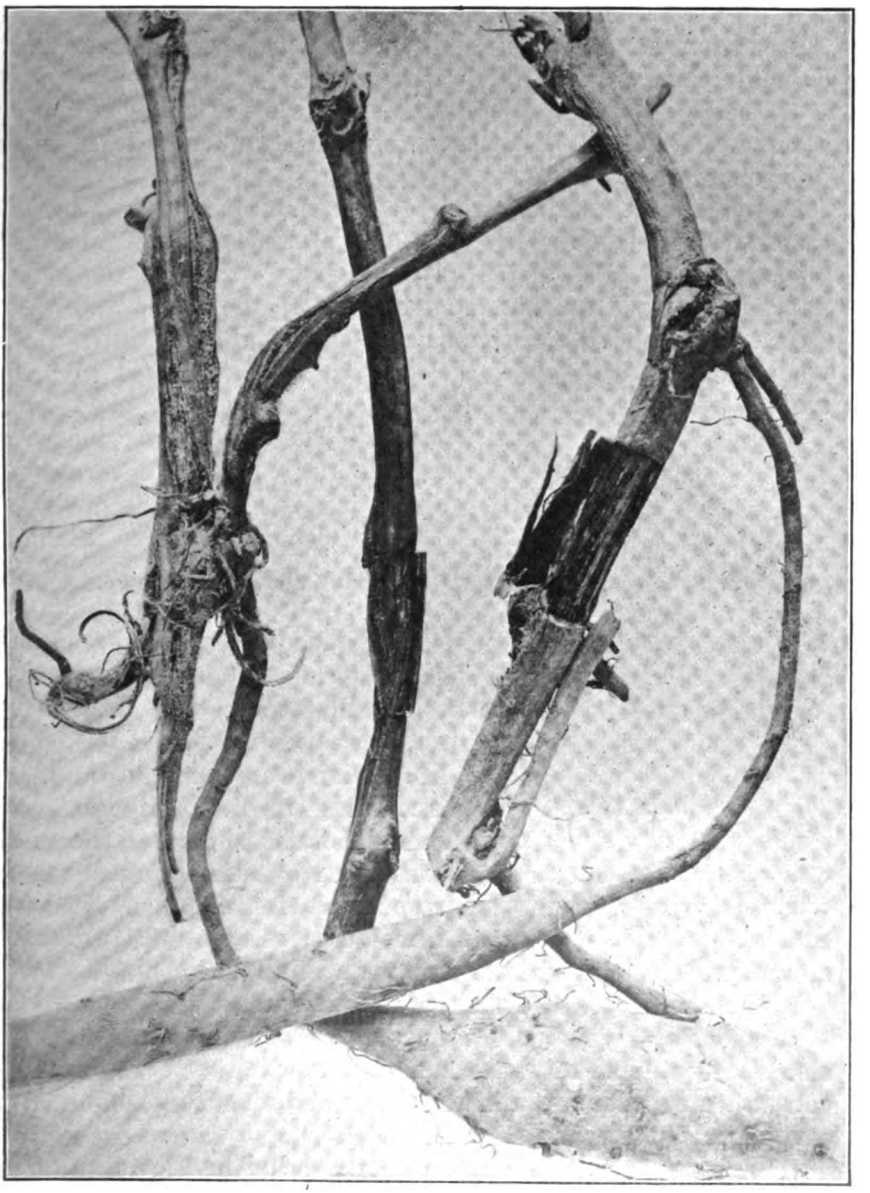

Fig. 85.—Sweet potato stems affected with wilt, also known as stem-rot. The stem on left shows split condition and spindling root; the other two stems show darkened interior tissues when the bark is removed. (After J. A. McClintock, Va. Truck Exp. Station, Bul. 22.)

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are not injured. It corrodes metals and therefore should be handled in wooden, glass or earthenware containers.

Make sweet potato beds somewhere in the woods on a virgin soil or at least on a soil new to sweet potatoes.

Don't use, for the beds or in the field, old sweet potato vines or manure mixed with them.

In the field plant sweet potato plants either in a new soil or in a soil which has not been used for this crop for at least three preceding years.

WILT OR STEM-ROT, YELLOW BLIGHT, BLUE STEM. The disease can be detected at first by a dull and then yellow color and puckered appearance of the leaves; later by wilting of the plants and rupturing, blackening and rotting of the stems (see Fig. 85). A faint purple tint can be seen through the white of the young plants infected with the trouble. Stems infected with the trouble will, on splitting, always show a distinct blackening inside. This blackening may extend in the vines for several feet and is a sure sign of the disease.

Fig. 86.— Sweet potato with one end cut off to show internal discoloration due to stem-rot fungus. (After L. L. Harter, U. S. Dept. of Agr., Far. Bulletin 714.)

This blackening often extends also into the potatoes as can be seen in Fig. 86. Such potatoes when bedded often produce plants that will also be diseased.

The disease is very destructive and, in certain cases, is known to kill nearly every plant in the field. According to L. L. Harter (see bulletin cited, p. 6), "at the most conservative estimate stem-rot is responsible for a loss of at least three-quarters of a million dollars annually to the sweet potato crop in the United States."

It is caused by two very closely related fungi, *Fusarium batatatis* and *Fusarium hyperoxysporum*. Though these fungi are also closely related to those causing wilts of other crops such as cotton, watermelon and tomatoes, they, so far, are not known to cause wilt of other crops.

At present the disease is known to occur in Florida and in many other states.

Control of wilt or stem-rot in all respects is the same as that of foot-rot except that a bin selection of the seed cannot be

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successful against this trouble. Sorting out potatoes from storage is not effective because the presence of the wilt fungus in them cannot be detected by any external symptom. Potato seed should be selected in the field shortly before digging time, but when the vines are still alive. This selection should be arranged in the following way: 1, select for seed purposes, a best yielding, uniform in all respects and most healthy looking field or part of a sweet potato field of a sufficient size; 2, go through every row of the seed patch and examine for wilt at least two vines from each hill. For this examination the vines must be cut off close to the point of their origin, that is where they began to grow from the draw or from the originally planted vine; these vines should then be split lengthwise and the inside color noted; wilt-affected vines will always show a distinct darkening. 3, every hill, vines of which on such examination showed darkening inside, and also every hill having any abnormal color of the leaves or prematurely dead vines, should be staked off during the examination for the wilt. 4, potatoes from the staked off hills should be dug out separately and before digging the entire seed patch so that they will not be mixed

Fig. 87.—Small sweet potato plant showing blackening of its underground basal part, due to black-shank fungus. (After L. L. Harter, U. S. Dept. of Agr., Far. Bulletin 714.)

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with seed potatoes. The former may be used in any way, of course, except for seed. 5, the seed potatoes remaining in the seed patch should be dug at the regular time and manner except that naturally special care must be observed in handling and storing them.

Fig. 88. — Sweet potato showing a round spot due to black-shank, also known as black-rot fungus. (After L. L. Harter, U. S. Dept. of Agr., Far. Bulletin 714.)

Just before bedding the potato seed, sort them over, disinfect and so on in the same way as recommended for the control of foot-rot.

BLACK-SHANK OR BLACK-ROT. This disease affects any underground part of sweet potato plants. On the draws it appears at first in the form of small, black spots as shown in Fig. 87. The spots in time enlarge and cause rotting off of the entire plant. On the potatoes it produces dark to nearly black, somewhat sunken, spots (see Fig. 88) with a metallic luster on the surface and greenish tissue beneath. The spots at first are small but often they may extend until the whole potato is rotted. Potatoes affected with black-rot when cooked have a very disagreeable taste and therefore should never be sold for human consumption; a few potatoes of this kind tasted by a consumer will surely turn him from this food product and thus the market will be greatly injured. Neither should such potatoes be used for seed because they will produce plants which most likely will also be affected with the disease.

Black-shank causes considerable damage in the seed bed and in the field by attacking draws, vines and roots; it also causes one of the most important storage rots, black-rot. On the whole, according to L. L. Harter, the disease causes a loss throughout

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the country "probably equal to that of all other diseases combined."

Black-shank (black-rot) is caused by the fungus *Sphaeronema fimbriatum*, which is distributed in about the same way as the fungus causing foot-rot and is controlled in the same way as the last named disease.

Summary of Control of Important Field Diseases

1. Fall selection of sweet potato seed free from wilt (see details under wilt).
2. Sorting and disinfection of seed potatoes just before bedding them.
3. Locating sweet potato beds in a virgin soil or soil new to this crop.
4. In the field rotate sweet potatoes with some other crops in such a way that sweet potatoes will not be planted in the same field oftener than once in four years.
5. Destruction of old potato vines or composting them and using for fields that are not to be used for sweet potato for at least three years hence.

Conclusion

In conclusion of this brief discussion of some most important sweet potato diseases it should be most emphatically stated that these diseases are chiefly responsible for most of the crop failures; that they, if not controlled in time, will become present in every field which is more or less regularly used for the culture of the crop, and that thus eventually will make the difficulties of cultivation manifoldly greater and the culture itself probably hardly profitable at all. But if the grower will follow the suggestions given for control of these diseases, and simultaneously pay due attention to the proper selection of sweet potato seed for higher yields and for better and more uniform types of potatoes, he will soon realize how much all this is to his own immediate profits and in that way, of course, to the benefit of the whole community.

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TERMITE INJURY TO SWEET POTATOES

E. W. BERGER

Owing to the great importance of the sweet potato weevil, *Cylas formicarius* Fab., sweet potato growers should be on the

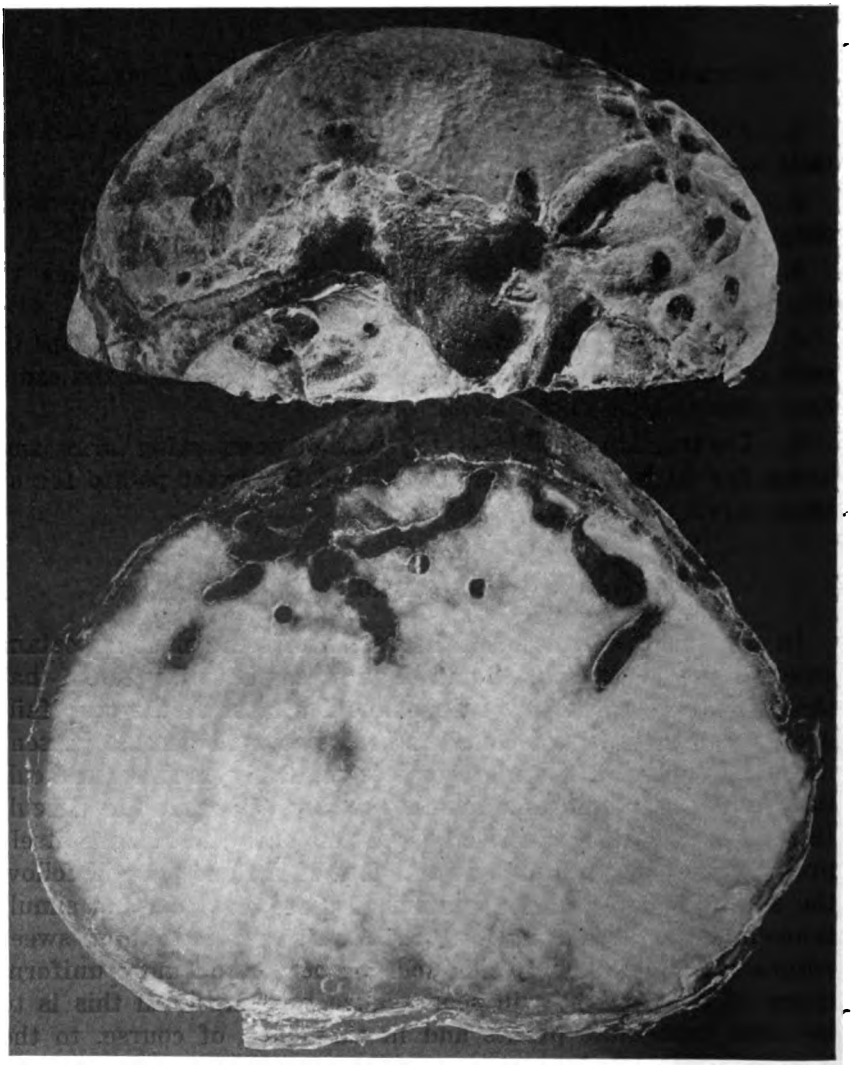

Fig. 89.—Sweet potato tuber showing tunnels by termites. Upper figure from outside; lower in cross section. Upper figure is top view of piece cut from potato to get section shown in lower figure. Natural size. (From a photo by E. W. Berger.) Compare with photo of injury by sweet potato root weevil, Fig. 72, Vol. II, No. 1, Oct., 1917.

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watch for it everywhere and especially in sections supposed to be free from the pest.

Among injuries most likely to be confused with the work of the sweet potato weevil are those caused by termites or "white ants". Injury by these insects to tubers is well illustrated by Figure 89. Comparison of this figure with Fig. 72, published on pg. 87 of the Quarterly Bulletin for October 1917, Vol. II, No. 1, will make several differences apparent:

1. Absence of larvae (grubs) and pupae in the tunnels when infested by termites, but their presence in apparent abundance when the tuber is infested with the weevil.

2. Absence of frass (excreta) when the injury is due to termites, but an abundance of this in the tunnels produced by the weevil.

3. Exit and entrance holes very apparent with termites, but tuber infested with weevil may show little or no outward evidence of its condition inside.

4. The clean-cut outlines of the tunnels made by the termites are in marked contrast with those made by the weevil.

Besides the differences indicated in the illustrations, several other facts of use in determining the presence of the weevil or termites may be noted:

5. If the plants are growing, tunneling larvae (grubs) in the stems near the ground indicate the weevil.

6. The presence of large (about ¼ in. long) ant-like insects with black heads and snout, brick-red thorax (middle) and legs, and dark steel-blue hind end, is an almost certain sign of the weevil.

7. The presence of whitish rapidly running insects, having much the appearance of ants, indicates termites.

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DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING JUNE 30, 1918

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending June 30, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING JUNE 30, 1918

Citrus grove trees inspected	2,299,163
Citrus nursery trees inspected	14,043,857
Inspectors employed	220
New properties showing infection	2
Total properties showing active infection	6
Grove trees found infected	13
Nursery trees found infected	0
Counties in which active infections were found	4

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914,	13,723
Nursery trees found infected since May, 1914,	342,254
Number properties infected to June 30, 1918,	479
Properties declared no longer "danger centers"	432
Properties still classed as "infected" June 30, 1918,	47

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1918:

1914		1915		1916		1917		1918	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1
		Mar.	444	Mar.	49	Mar.	9	Mar.	1
		Apr.	408	Apr.	49	Apr.	169	Apr.	2
May	108	May	1042	May	338	May	52	May	1
June	160	June	772	June	450	June	45	June	10
July	275	July	651	July	349	July	39		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30		
Sept.	767	Sept.	618	Sept.	124	Sept.	6		
Oct.	565	Oct.	214	Oct.	451	Oct.	2		
Nov.	773	Nov.	494	Nov.	131	Nov.	1		
Dec.	366	Dec.	256	Dec.	27	Dec.	1		

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QUARANTINE DEPARTMENT*

REPORT FOR QUARTER ENDING JUNE 30, 1918.

The following reports on the inspections of shipments and importations, all ports and stations, have been compiled by Mr. K. E. Bragdon, Assistant Quarantine Inspector:

PORT AND RAILWAY INSPECTION

SHIPS AND VESSELS INSPECTED:			
From foreign ports	475		
From U. S. ports other than Florida	273		
From Florida ports	200		
Total		948	
SHIPMENTS INSPECTED:			
Arriving by water:			
Passed	1868		
Treated and passed	18½		
Returned to shipper	37		
Detained, subject to return by shipper	0		
Contraband destroyed	300½		
		2224	
Arriving by land—Express, Freight, Wagons, etc.:			
Passed	302		
Treated and passed	27		
Returned to shipper	45		
Detained, subject to return by shipper	25		
Contraband destroyed	12		
		411	
Total shipments inspected			2635

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	No. of parcels infested
Aphis sp.	Rose	Connecticut	3
Aphis sp.	Rose	Cuba	1
Aspidistra scale	Fern	Georgia	1
Aspidistra scale	Hibiscus	Florida	1
Aspidistra scale	Sour sop	Cuba	1
Bephrata cubensis	Sour sop	Cuba	3
Black scale	Grape	Ohio	1
Chaff scale	Citrus	Cuba	1
Chaff scale	Palm	Georgia	1
Chaff scale	Sour sop	Cuba	1
Cocoanut mealy-bug	Avocado	Florida	1
Coffee-bean weevil	Coffee	Brazil	1
Corn weevil	Corn	Mexico	1
Crown gall	Geranium	Massachusetts	1
Crown gall	Peach	Georgia	1
Crown gall	Raspberry	New York	1

*By action of the State Plant Board, taken on May 10, 1918, the name of the "Port and Railway Inspection Department" was changed to that of "Quarantine Department". The latter Department, as now organized, includes the parcel post inspection, control and eradication of sweet potato weevil and eradication of the banana root borer. Problems involving essentially quarantine measures will come within the province of this Department.

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Insect or Disease	Occurring on	From	No. of parcels infested
Dictyospermum scale	Cocoanut	Cuba	1
Dictyospermum scale	Jasmine	Cuba	1
Florida red scale	Palm	Florida	1
Florida red scale	Rose	Cuba	1
Hemisphaerical scale	Palm	Massachusetts	1
Hemisphaerical scale	Sour sop	Cuba	1
Hemisphaerical scale	Unknown plant	Florida	1
Leaf hopper	Cotton	Spain	1
Long scale	Citrus	Cuba	1
Long-tailed mealy-bug	Hibiscus	Florida	1
Long-tailed mealy-bug	Unknown plant	Florida	1
Mealy-bug	Coleus	Maryland	1
Mealy-bug	Coleus	Ohio	1
Mealy-bug	Sour sop	Cuba	1
Nematode root-knot	Blackberry	North Carolina	1
Nematode root-knot	Fig	Florida	1
Nematode root-knot	Grape	Texas	1
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Rose	Florida	1
Oyster-shell scale	Snowball	Pennsylvania	1
Phyllocoptes sp. (mite)	Cereus	Mexico	1
Pseudoscorpion	Citrus	Spain	1
Psocus sp.	Sour sop	Cuba	1
Purple scale	Boxwood	Georgia	1
Purple scale	Citrus	Cuba	2
Pustule scale	Holly	Florida	1
Pyriform scale	Honeysuckle	Florida	1
Red bay scale	Jacob's ladder	Florida	1
Red bay scale	Magnolia	Florida	1
Rose slug	Rose	Connecticut	1
San Jose scale	Cherry	Massachusetts	1
San Jose scale	Currant	Massachusetts	1
San Jose scale	Currant	Ohio	1
San Jose scale	Hydrangea	Massachusetts	1
San Jose scale	Peach	Massachusetts	1
San Jose scale	Peach	Ohio	1
San Jose scale	Plum	North Carolina	1
San Jose scale	Plum	Ohio	1
Soft brown scale	Fern	Massachusetts	1
Soft brown scale	Palm	Florida	1
Soft brown scale	Sour sop	Cuba	1
Sweet potato weevil	Sweet potato	Cuba	2
Thrips	Rose	Connecticut	1
Tortoise beetle	Guava and citrus	Cuba	1
Tussock moth	Unknown plants	Massachusetts	1
Walnut scale	Cherry	Massachusetts	1
Walnut scale	Currant	Massachusetts	1
Walnut scale	Peach	Massachusetts	1
Walnut scale	Peach	South Carolina	1
Whitefly	Jasmine	Florida	1

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Parcel Post Plant Inspection

Parcels Inspected:

Passed	3193	
Treated and passed	68	
Returned to sender	6	
Detained, subject to return by sender	1	
Infested or infected parcels destroyed	0	
Total parcels inspected		3268

Principal Pests and Diseases Intercepted

Insect or disease	Occurring on	From	No. of parcels infested
Crown gall	Rose	Ohio	3
Florida red scale	Citrus	Florida	1
Florida red scale	Ivy	Florida	1
Melanose	Citrus	Florida	1
Nematode root-knot	Geranium	Ohio	2
Nematode root-knot	Hibiscus	Ohio	3
Nematode root-knot	Lemon verbena	Ohio	1
Nematode root-knot	Petunia	Ohio	1
Nematode root-knot	Plumbago	Ohio	1
Nematode root-knot	Rose	Ohio	59
Nematode root-knot	Rose	Georgia	1
Nematode root-knot	Wistaria	Ohio	1
Palmetto scale	Palmetto	Florida	1
Pustule scale	Holly	Florida	1
Soft brown scale	Cape Jasmine	Florida	1
Soft brown scale	Cut flowers	Florida	1
Soft brown scale	Ivy	Florida	1
Whitefly	Cut flowers	Florida	3

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

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Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

The following editorial by David B. Mackie, taken from the June, 1918, issue of the Monthly Bulletin of the California State Commission of Horticulture, describes all too well a condition which even Florida has experienced in times past and a condition which, in the aggregate, has cost the United States countless millions of dollars. Fortunately, the citrus growers and members of the Florida legislature have, during recent years, proven themselves exempt from the narrowness of viewpoint which is illustrated in this editorial. It is to be devoutly hoped that the broad viewpoint and foresight which made possible the, to date, successful campaign against citrus canker will characterize the deliberations of our Florida statesmen and citizens when serious situations are confronted in the future:

"WHERE DOES THE BLAME BELONG? From Australia comes the report that citrus canker has made its appearance in the commonwealth. True to tradition, the uninformed public through the press does not hesitate to jump to the horticultural officers and lay the blame for allowing the importation at their door.

"This is in a large measure to be expected. These officials furnish a convenient object for attack at this time when a certain amount of invective must be expended.

"Not being in a position to state with authority on whom devolves the responsibility for allowing the introduction of canker into Australia, but having had a certain amount of experience in securing and enforcing hor-

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ticultural legislation, speaking in the abstract it should be stated that there are many aspects of such problems that are seldom brought to the notice of the public.

"The assertion is ventured that there are, among those who will read this article, horticultural officials who have had a chance to wear themselves out trying to squeeze from a reluctant legislature funds for the purpose of providing a means of preventing the introduction of some plant pest or disease that may be causing consternation in some other part of the world and which it is realized will sooner or later be brought to their shores. Nor is the legislature entirely to blame. Such bodies as a rule are generally composed of individuals largely ignorant of the bionomics of insect pests and plant diseases, without training in the estimation of evidence in this line, and withal unable to appreciate the extent or imminence of danger which may be anticipated from this source. The responsibility may often be traced farther back to the fruit growers themselves, who, with full knowledge of the true significance of the menace, adopt the let-George-do-it attitude and wait for someone else to take the initiative. There may be meetings held and resolutions prepared but concerted action and a follow-up policy are largely lacking. Interest wanes until the eleventh hour when the pest in question appears and their chance has vanished. This attitude is particularly reprehensible as they must surely understand fully that whatever happens they will be the losers.

"As a result of this combination of circumstances pleas for preventive rather than remedial measures too often receive a deaf ear and the matter is often viewed from the standpoint that the originator of these measures is either exceedingly hard up for something to do or else desires to distribute a little political patronage. Whatever the reason, the results are always the same. In tracing the course of introduced plant pests and diseases it is an unwritten law that the government which has failed to take necessary precaution in providing adequate means to prevent the introduction of undesirable alien plant pests and diseases sooner or later, but nevertheless surely, has an opportunity to 'chew the cud of bitter reflection' and dig down into its coffers to the extent of about one hundred times the amount a proper insurance against this class of undesirable aliens would have cost.

"It may seem a far cry, but perhaps some day it will be recognized that any insect or pathogenic organism which utilizes as a host some particular plant, no matter in what part of the world that host plant may exist, without proper protective measures, becomes in this day of modern transportation facilities a potential pest throughout the entire region where such plant may be grown.

"California has had an opportunity to view the case in its different aspects. The price of her knowledge has been the alternative between destruction of her citrus industry or the annual expenditure of large sums of money to keep under control a host of these introduced enemy aliens brought into her midst before the potentialities of such things began to be appreciated. Viewing her experiences in retrospect, she now purchases insurance against their further introduction, these by a judicious system of quarantines and a trained inspection service exceeded by none and equalled by few. It is believed that a few pages taken from the experiences of our state will well repay the trouble."

THE DELAY IN GETTING OUT THIS NUMBER of the Quarterly Bulletin is keenly regretted by the editors. It should have appeared not later than July 15th.

It is customary in these times to charge the Hun with most calamities, upset plans and inconvenient happenings, and so in the present instance we must charge the Hun and his allies, the

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black fly and the semi-tropical army worm, with our troubles.

As will be noted from the "Honor Roll" on the first pages of this issue, 68 of the Plant Board's trained inspectors are either "over there" or getting ready to go over shortly. New men have not been employed to take the place of these absent inspectors, but the work of the Plant Board has, through the earnest and untiring efforts of its employees remaining, continued on as large a scale as ever and, we hope, as efficiently. Not only has the canker eradication work been pushed with vigor and apparent success but an active campaign to eradicate the banana root borer has apparently been successful and much has been accomplished in restricting the spread of the sweet potato weevil.

The editor was obliged to be in Cuba during the early days of July in connection with investigations of the black fly, that we may the more effectively protect Florida from this enemy, and during the latter part of July severe outbreaks of the semi-tropical army worm in several Florida counties required the undivided attention of our force to the end that many thousands of acres of castor beans might be saved from destruction. To the Hun and these allies of his, the delay in preparing this issue is certainly due. We let it go at that. (August 3, 1918.)

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THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

Volume III

1918-'19

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Published by
STATE PLANT BOARD OF FLORIDA
Gainesville, Florida.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

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OF THE

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OF FLORIDA

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. III JANUARY, 1919 No. 2

REPORT OF THE STATE PLANT BOARD FOR THE BIENNIAL PERIOD ENDING APRIL 30, 1918

(SECOND BIENNIAL REPORT)

AND SUPPLEMENTAL REPORTS

LETTER OF TRANSMITTAL

December 31, 1918.

To His Excellency,
Sidney J. Catts,
Governor of Florida.

SIR: Herewith is submitted the report of the State Plant Board of Florida for the biennium ending April 30, 1918, with supplemental report to September 30, 1918. We request that you submit same to the Legislature.

Respectfully,
STATE PLANT BOARD,
By JOE L. EARMAN,
Chairman.

REPORT OF STATE PLANT BOARD

The work of the State Plant Board has been vigorously prosecuted during the past two years and we believe that the results obtained fully justify the conclusion that the Board has rendered services to the agricultural interests of Florida many times in excess of the amounts expended. In its various lines of work the Board has received unstinted co-operation and support from those most affected by its activities and, on the other hand, has been freely granted the counsel and advice of other agricultural institutions, such as the University of Florida Experiment Station, the State Department of Agriculture, the United States Department of Agriculture and the Federal Horticultural Board.

PERSONNEL OF BOARD

The terms of Messrs. P. K. Yonge, F. E. Jennings and W. D. Finlayson expired on July 2, 1917. Your Excellency appointed, to succeed them as members of the Board, Mr. H. J. Brett, of DeFuniak Springs, Mr. Joe L. Earman, of Jacksonville, and Mr. J. B. Hodges, of Lake City. Mr. Brett was commissioned as a member of the Board on July 8, Mr. Earman on July 2, and Mr. Hodges on July 3, 1917. These gentlemen, together with the two remaining members of the Board, Messrs. E. L. Wartmann, of Citra, and T. B. King, of Arcadia, met at Jacksonville on July

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23, organized, and elected Mr. Earman as Chairman. At the same meeting Mr. Bryan Mack, of Pensacola, was elected Secretary, and Mr. J. G. Kellum, of Tallahassee, Auditor. Later in the season Mr. Brett, on account of his duties as a member of the Federal District Board of the Northern District of Florida, found it necessary to resign from the Plant Board, his resignation having been submitted on September 11, 1917. Your Excellency appointed Mr. J. T. Diamond to succeed him and Mr. Diamond was commissioned on September 12, 1917.

Advisory Committee

The Plant Board, when first organized on May 4, 1915, did not find available a suitably qualified person for the position of Plant Commissioner and therefore selected an "Advisory Committee", consisting of Messrs. L. S. Tenny of Orlando, W. J. Krome of Homestead and P. H. Rolfs of Gainesville, this committee acting as Plant Commissioner until the election of Mr. Wilmon Newell to the latter position in July, 1915. Following the election of the Plant Commissioner, the Advisory Committee continued to serve, assisting both the Board and the Commissioner until the Board's work was thoroughly organized and a force of inspectors assembled and trained for the work in hand. The members of this Committee resigned August 14, 1916, after having rendered, without compensation, most valuable service to the Board and to the State of Florida.

Citrus Canker Eradication

The occurrence of citrus canker in Florida was without doubt the immediate reason for the creation of the State Plant Board by the Legislature, and the Board, immediately upon its organization in May, 1915, was confronted with the tremendous task of bringing this disease under control and eradicating it. In this work, conducted in co-operation with the Bureau of Plant Industry, United States Department of Agriculture, very satisfactory progress has been made. The speed with which the disease has been reduced in the State is indicated by the number of canker infected trees found during the different years. During the year 1915, 6,715 infected trees were found and destroyed; during the year 1916, 2,294 infected trees were found; while during the calendar year 1917 only 372 were found in the entire State. From January 1 to December 31, 1918, 15 infected trees were found. This rate of decrease would indicate that, barring unexpected developments, the disease will probably be eradicated

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from the State within the next two years if the present campaign is conducted to its logical conclusion.

Other Important Work

The efforts of the Plant Board have not been confined by any means to the eradication of citrus canker, but material service has been rendered various agricultural industries in the State in affording them protection from new pests and in controlling many pests already present in different sections.

The banana root borer, an insect destructive to bananas and sugar cane, has during the past year been discovered at three points in the State, and in all three cases prompt eradication measures were undertaken by the Plant Commissioner's forces in co-operation with the Federal Horticultural Board, and it is believed that these outbreaks have been successfully stamped out.

The sweet potato weevil has made the commercial production of sweet potatoes impossible in several Florida counties. By means of suitable quarantine measures the Plant Board is restricting the further distribution of this pest, thus making possible the continuation of sweet potato culture in the greater portion of Florida.

Severe outbreaks of the semi-tropical army worm in July and August, 1918, threatened to destroy several thousand acres of castor beans being grown under contract for the Government. Active work on the part of the Plant Board inspectors, in co-operation with representatives of the United States Department of Agriculture, resulted in this outbreak being promptly checked and the damage by the pest reduced to a minimum, thus saving for the use of the Bureau of Aircraft Production large quantities of castor beans which would otherwise have been destroyed.

The quarantine work carried on by the Plant Board at the various ports and junction points in Florida is perhaps the most important line of work in which the Board is engaged, and is work which is absolutely essential to the future preservation of many agricultural and horticultural crops in Florida. For example, the quarantine work has thus far been fully effective in keeping out of Florida the black fly, a pest of fruit trees which occurs in Cuba, Jamaica, the Bahamas and the Panama Canal Zone, and which, if introduced into the State, would require probably as heavy expenditures for its eradication as has citrus canker. Many very destructive pests and diseases are kept out

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of Florida through the efficient work of the Board's quarantine inspectors. In this work the Federal Horticultural Board cooperates, but the State Plant Board is called upon to defray all expenses in connection therewith. The importance of the quarantine work is only fully understood when one realizes the extent to which climatic conditions in Florida permit of the rapid increase and destructiveness of a great variety of insect pests and plant diseases.

The Plant Board has been fortunate in having inspectors and employees who were devoted to the work in hand and who have been exceedingly loyal to the State and its interests. Efficiency has been the sole basis upon which employment has been granted, and in no case has any position been filled for political reasons or through personal favoritism.

The Plant Board has willingly given 75 of its trained employees for service in the Army and Navy of the United States, and has fortunately been able to carry on its work in an efficient manner without replacing these trained men with new and inexperienced ones.

The work being conducted under direction of the Plant Board is of the utmost importance to all agricultural industries in Florida and results directly in substantial increase in many food crops and will, with proper support, be in the future the best safeguard possible for our various agricultural and horticultural industries. This work is deserving of all needed support in the form of appropriations from State funds.

Your Board has given careful consideration to the needs of the agricultural industries of the State for protection and recommends that the sum of $280,630.00 be appropriated for the work of the Plant Board for the coming biennial period, this amount, however, including the $35,000.00 annual continuing appropriation already provided for by Chapter 6885, and being exclusive of amounts required for completing the eradication of citrus canker. The items comprised in this estimate are given on pages 105-108.

For completing the canker eradication work and for such inspection of citrus groves as is necessary to prevent recurrences of the disease, it is estimated that $125,000.00 will be required during the fiscal year ending June 30, 1920, and $100,000.00 during the year ending June 30, 1921, which amounts should be provided, either by appropriation or special taxation.

Further details as to the work done by the Board during the past two years will be found in the Plant Commissioner's report which is transmitted herewith.

JOE L. EARMAN,
Chairman.

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REPORT OF THE PLANT COMMISSIONER FOR THE BIENNIUM ENDING APRIL 30, 1918 and SUPPLEMENTAL REPORTS

Hon. Joe L. Earman, Chairman,
State Plant Board of Florida.

SIR: I have the honor to submit herewith my report on the work of the various Departments of the State Plant Board's organization for the two fiscal years ending April 30, 1918, together with a supplementary report covering the period from May 1, 1918, to October 31, 1918.

Respectfully,
WILMON NEWELL,
Plant Commissioner.

It is a pleasure to report that, during the biennium, substantial accomplishments have characterized all lines of work under way or inaugurated by the State Plant Board in accordance with the Florida Plant Act of 1915. The quarantine work at Florida ports has prevented in many instances the introduction of serious insect pests and diseases which are not known to occur in Florida, while the parcel post inspection has prevented the delivery to Florida citizens of many thousands of diseased food-producing and ornamental plants. The progress made in the eradication of citrus canker has been all that could be expected by the most optimistic advocates of this work. The nursery inspection work has been so efficient that no instance has yet come to light of any serious insect pest or plant disease being disseminated from Florida nurseries since the Plant Board commenced its activities. Much has been accomplished in checking the spread of the sweet potato weevil and the Board has been able to maintain, thus far at least, an impenetrable barrier to the entrance of the black fly, a most serious insect pest occurring in Cuba, Jamaica, The Bahamas and the Canal Zone.

On several occasions the organized inspection forces of the Board have been able to give immediate assistance in times of public necessity and have thus been enabled to save many thou-

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sands of dollars worth of property in ways not originally contemplated by the Plant Act.

The measures of success attained along these lines must be credited to the broad views and conservative decisions of the Board itself, full co-operation by Florida citizens, and the enthusiastic and loyal service of its employees.

However, the steady and uninterrupted prosecution of the Board's work has not been without difficulties. Constantly increasing salaries for skilled workers and technically trained men have resulted in the Board losing many of its employees, and in the case of many of those remaining, the Board has been compelled, for the preservation of its work, to pay higher salaries than formerly. This, coupled with the tremendously increased cost of all materials and supplies necessary in its work, has made it impossible for the Board to decrease its scale of expenditures as rapidly as was hoped for. In no case, however, have appropriations been exceeded or deficits created.

Increased shipping at Florida ports, coupled with necessary precautions on the part of military and naval authorities, has also greatly increased the difficulties attending our quarantine work.

Military Service

In spite of the fact that the work of the Plant Board is one directly instrumental in conserving and protecting important food crops, it has given its employees ungrudgingly for service in the Army, Navy and Aviation Section. Sixty-nine of its employees are now in such service. Their names will be found on pages 159-160 of The Quarterly Bulletin, Vol. II.

These men have not been replaced by new employees, but those remaining have patriotically exerted every energy with the result that both the scale and efficiency of the work have been maintained and considerable economy effected at the same time.

RULES AND REGULATIONS

The primary purpose of the Plant Board is to prevent the introduction and dissemination of injurious insects and plant diseases and to effect the control and eradication of such. To this end certain quarantine measures are necessary, authority to make and enforce which is vested in the Board by the Plant Act of 1915.

Rules 1 to 27, inclusive, adopted by the Board between May

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1, 1915, and October 31, 1916, were submitted with my last report. Since that report the Board has made such amendments to its existing rules as circumstances and experience made advisable and in addition adopted new rules to meet new dangers or new conditions. These rules have been as follows:

Rule 28, prohibiting the importation into Florida from Jamaica, of all pineapples and pineapple plants, to prevent the introduction of the pineapple black weevil, and Rule 29, requiring special treatment of nursery stock shipped from nurseries in sections where the Dictyospermum scale is known to exist, were adopted by the Board on January 8, 1917.

Rule 30, providing for the disposition of infested or infected shipments of nursery stock, adopted February 12, 1917.

Rule 31, specifying the qualifications for inspectors of the Plant Board, and requiring applicants to pass a satisfactory examination prior to employment, adopted April 9, 1917.

Rule 32, regulating the shipment of sweet potato plants and tubers into Florida, to prevent the further introduction of the sweet potato weevil, adopted August 13, 1917.

Rule 33, prohibiting the shipment of sweet potato plants from areas infested by the sweet potato weevil, and Rule 34, regulating the shipment of sweet potato tubers from areas infested by this weevil, in order to prevent its continued spread, were adopted September 13, 1917. Rule 35, prohibiting the pasturing of live stock in citrus canker infected properties, was adopted on the same date.

Rule 36, requiring the disinfection of field boxes by public fruit packing houses, adopted October 8, 1917.

Rule 37, regulating the importation of cotton seed, cotton waste, etc., in order to prevent the introduction into Florida of the pink bollworm of cotton, adopted December 10, 1917.

Rule 38, requiring common carriers and their agents to hold under quarantine prohibited shipments, etc., adopted February 21, 1918.

The above rules and all amendments to rules were published in the "Circulars" of the Board, Nos. 18 to 29 of which, inclusive, were published during the biennium.

All Rules and Public Notices of the Board, as in effect on

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April 30, 1918, will be found in Circular No. 30 (issued July 31, 1918).

CITRUS CANKER ERADICATION

The work of eradicating citrus canker has progressed very satisfactorily during the biennium. As heretofore, the work has been carried on in close co-operation with the Bureau of Plant Industry, United States Department of Agriculture, under the direction of the Plant Commissioner, ably assisted by the General Inspector, Mr. Frank Stirling.

For convenience, the work done during the two fiscal years is here treated separately.

YEAR ENDING APRIL 30, 1917

During this period but one new center of infection (at Groveland, Lake County) was discovered.

The number of employees during the year remained practically stationary, the lowest number being 342 in May of 1916, and the largest number 418 in August and September of the same year.

Inspections during the year embraced 17,635,646 citrus trees planted in grove formation and 51,882,397 in nursery formation. Many of these trees were, of course, inspected more than once; the figures given are the total number of tree-inspections.

The area inspected during the year embraced the greater portion of what is generally regarded as the citrus-producing section of the State and also extended to other portions of the State where citrus is not produced in large quantity.

As has been the case at all times since inspection work was undertaken, trees that had been planted from nurseries in which citrus canker was afterwards found have been constantly under close surveillance. It is gratifying to report that as a result of this inspection of suspected shipments, the inspectors were able to find but one infection which had previously been unknown.

Reinspection work has been maintained continuously in properties known to have been infected and all grove properties adjacent to infected areas have been kept under constant observation.

A "scout inspection", that is, inspection of citrus trees in

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sections not previously inspected, has been carried on as rapidly as conditions in the infected centers permitted and substantial progress has been made in scouting the citrus-producing areas of the State.

During the fiscal year a total of 2,285 grove trees and 483 nursery trees were found infected with citrus canker. These were located on a total of 142 properties in 13 counties. Of the 142 properties in which infected trees were found, 74 had not previously shown infection.

During the year, also, the State Plant Board declared as being "no longer danger centers" with reference to citrus canker, 213 properties previously infected. At the end of the fiscal year there remained 146 properties classed as actively infected.

A full measure of co-operation was received from growers generally. One substantial indication of this co-operation is found in the fact that during the fiscal year owners of trees which had been exposed to infection gave permission for the destruction of 47,584 grove trees and 10,029 nursery trees.

There was expended in the canker eradication work in Florida during the fiscal year a total of $405,390.10, of which amount $393,994.85 was paid out of Federal funds by the Bureau of Plant Industry and $11,395.25 by the State Plant Board. Expenditures by months are shown in the following table:

		Bur. of Plant Industry	State Plant Bd.	
May	1916	$ 25,473.80	$ 467.08	
June	"	32,233.32	989.65	
July	"	37,202.84	317.97	
August	"	40,459.02	281.64	
September	"	41,818.31	427.88	
October	"	35,959.38	760.48	
November	"	34,463.36	397.60	
December	"	33,751.29	535.73	
January	1917	33,639.76	242.68	
February	"	19,415.87	5,228.52	
March	"	26,203.95	236.79	
April	"	33,373.95	1,509.23	
		$393,994.85	$11,395.25	
Total				$405,390.10

Other essential facts concerning the canker eradication work during the year are given in Table I, prepared by Mr. Frank Stirling.

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TABLE I

TABULATED REPORT OF THE CITRUS CANKER ERADICATION DEPARTMENT FOR THE YEAR ENDING APRIL 30, 1917
Prepared by Frank Stirling, General Inspector

	Number of employees on force	Number of trees inspected for citrus canker. (Many trees were reinspected a number of times. The figures below include such reinspections.)		Number of counties in which citrus canker was found	Number of properties in which citrus canker was found	Number of trees found infected and destroyed.		Number of "exposed" trees destroyed as a precautionary measure.		Number of properties newly infected	Number of properties declared no longer actively infected	Number of properties classed as "active infections"
		Grove	Nursery			Grove	Nursery	Grove	Nursery			
1916												
May	342	1,317,262	2,439,000	8	39	338	268	6361	0	9	0	294
June	378	1,716,502	3,307,182	7	53	450	82	2947	0	9	0	303
July	399	1,489,849	7,303,059	9	42	349	46	4848	0	9	19	293
August	418	1,866,807	2,139,361	8	51	219	9	4039	0	9	2	300
Sept.	418	1,819,692	2,153,961	9	44	124	32	7335	0	7	1	306
October	364	1,378,269	1,813,733	8	35	451	11	5759	0	11	164	153
Nov.	389	1,472,639	5,077,603	5	28	131	3	1236	0	4	6	151
Dec.	372	1,362,610	5,756,225	3	12	27	0	4601	0	4	5	150
1917												
January	378	1,396,031	4,095,851	4	11	14	0	4278	10,000	2	8	144
February	368	878,166	5,791,637	4	5	4	3	1453	0	0	4	140
March	365	1,176,830	5,884,266	2	5	9	4	1327	4	0	2	138
April	363	1,760,989	6,120,519	7	24	169	25	3400	25	10	2	146
Totals		17,635,646	51,882,397	13*	142**	2285	483	47584	10,029	74	213	
Totals prior to May 1, 1916				21		11247	341,770	59237	2,539,834	382	97	
Grand totals				22		13532	342,253	106821	2,549,863	456	310	146

*Infections reported from 13 counties for year 1916-17. One newly infected county reported for year 1916-17 (Lake). Total number of counties infected to April 30, 1917, 22.

**Actual number of properties upon which infected trees were found during year 1916-17.

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Year Ending April 30, 1918

No new centers of infection were found during the year.

The number of employees engaged in the canker eradication work steadily decreased during the year, the number being 334 in June, 1917, and 220 in April, 1918.

During the fiscal year 13,285,865 citrus trees in grove formation and 51,736,342 in nursery formation were inspected. The inspection of trees previously shipped from nurseries under suspicion was continued during the year but no new centers of infection were found.

Reinspection and scout inspection were continued as during the preceding year and the first scout inspection completed in several counties.

During the year 180 grove trees and 1 nursery tree were found infected. These infected trees were found in 34 properties, located in 7 counties. Of the 34 properties in which infections occurred, 4 had not previously shown infection.

As a result of being in close proximity to infected properties or consisting wholly or in part of trees shipped from infected nurseries prior to the beginning of the eradication work a total of 10,257 grove trees and 80,000 nursery trees were destroyed during the year with the consent of the owners.

During the year 116 additional infected properties were declared by the Board as being no longer danger centers with reference to citrus canker infection.

Declaring Properties "Clean"

Prior to October, 1917, the Board had taken no action with reference to canker-infected properties other than to declare them as being "no longer danger centers" with reference to canker infection. This action, while releasing the property from many phases of the quarantine and permitting the planting of citrus on adjacent properties, did not remove all restrictions. Work in the property, for example, was still required carried on under certain precautions, and replanting of citrus thereon was prohibited.

In October, 1917, the Board gave careful consideration to 76 properties, formerly infected, and concluded that all danger of further infections in these properties was over. They were accordingly declared "clean" by resolution of the Board, and all restrictions of every character, due to past infections, were

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TABLE II

TABULATED REPORT OF THE CITRUS CANKER ERADICATION DEPARTMENT FOR THE YEAR ENDING APRIL 30, 1918

Prepared by Frank Stirling, General Inspector

	Number of employees on force.	Number of trees inspected for citrus canker. (Many trees were reinspected a number of times. The figures below include such reinspections.)		Number of counties in which citrus canker was found	Number of properties in which citrus canker was found	Number of trees found infected and destroyed.		Number of "exposed" trees destroyed as a precautionary measure.		Number of properties newly infected	Number of properties declared no longer actively infected
		Grove	Nursery			Grove	Nursery	Grove	Nursery		
1917											
May	326	1,648,258	7,321,698	6	18	52	1	2142	0	2	7
June	334	1,067,557	5,115,519	5	16	45	0	2690	40,000	0	23
July	322	1,132,645	4,097,421	6	10	39	0	1241	25,000	1	0
August	316	724,548	3,350,419	7	17	30	0	486	0	1	0
Sept.	300	859,511	2,787,141	3	4	6	0	467	15,000	0	1
October	286	1,005,998	2,738,029	1	2	2	0	916	0	0	63
Nov.	269	1,189,627	3,983,727	1	1	1	0	30	0	0	6
Dec.	257	1,165,773	3,673,964	1	1	1	0	277	0	0	5
1918											
January	246	1,374,947	4,407,137	0	0	0	0	1288	0	0	3
February	238	1,224,949	4,776,319	1	1	1	0	359	0	0	1
March	224	1,045,291	4,760,295	1	1	1	0	343	0	0	0
April	220	846,761	4,724,673	1	2	2	0	18	0	0	7
Totals		13,285,865	51,736,342	7*	34**	180	1	10257	80,000	4	116
Totals prior to May 1, 1917				22		13532	342,253	223463	2,531,514	473	310
Grand totals				22		13712	342,254	233720	2,611,514	477	426

*Infections reported from 7 counties for the year 1917-18. No newly infected counties reported for the year 1917-18. Total number of counties infected to April 30, 1918, 22.

**Actual number of properties upon which infected trees were found during year 1917-18.

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removed therefrom. Thus they were released for replanting to citrus under normal conditions.

In November, 1917, 1 property was declared clean; in December, 1917, 5; in February, 1918, 9; and in March, 1918, 2, making a total of 93 properties from which during the fiscal year absolutely all restrictions were removed.

There was expended in the canker eradication work during the year a total of $313,807.84, of which amount $187,776.24 was by the Bureau of Plant Industry and $126,031.60 by the State Plant Board. Expenditures by months are shown in the following table:

		Bur. of Plant Industry	State Plant Bd.	
May	1917	$ 28,541.00	$ 252.27	
June	"	29,116.92	1,262.77	
July	"	28,198.08	157.33	
August	"	26,943.31	123.27	
September	"	25,642.80	172.65	
October	"	23,681.53	1,866.52	
November	"	41.30	28,635.62	
December	"	1.00	25,115.19	
January	1918	1.00	25,709.41	
February	"	1.00	24,244.57	
March	"	13,475.10	9,217.28	
April	"	12,133.20	9,274.72	
		$187,776.24	$126,031.60	
Total				$313,807.84

Further details concerning the year's work will be found in Table II.

Figure 1 shows, in graphic form, the number of canker infected trees found each month from May, 1914, to April 30, 1918.

Figure 2 shows the number of canker-infected properties found in the State, and the number of such properties declared no longer danger centers, at the end of each month, from May, 1914, to April 30, 1918.

Legal Actions

At the time of my last report, November 30, 1916, warrants had been issued charging four parties with planting citrus trees in areas in which such planting was prohibited by rules of the Board because of danger of infection by citrus canker. Two of the parties thus charged afterwards plead guilty and fines were imposed. The two remaining cases were nolprossed.

During the biennium it has not been necessary to bring either civil or criminal actions in connectiion with the work of eradicating citrus canker, co-operation on the part of growers having become practically universal.

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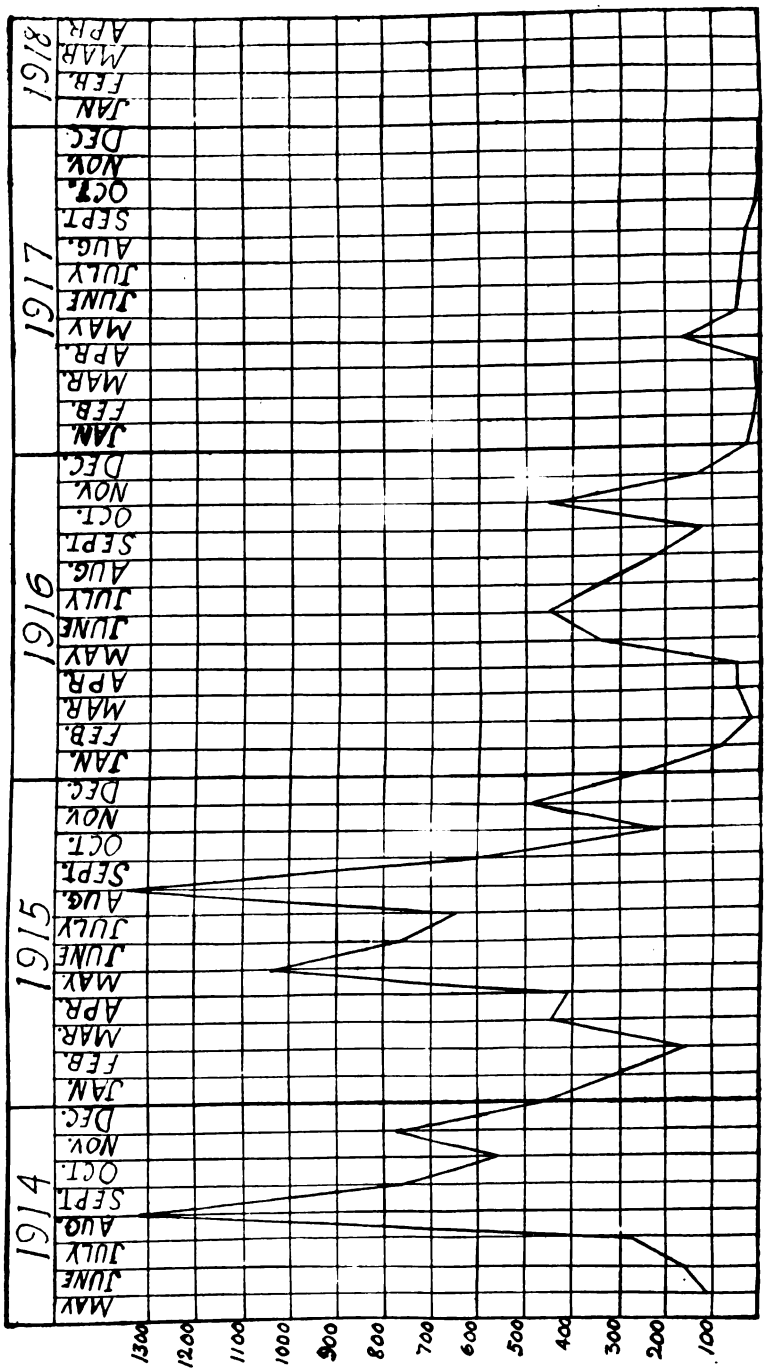

Fig. 1. Diagram showing the number of canker-infected grove trees found in Florida each month from May 15 1914 (when eradication work was begun by the Florida Growers' and Shippers' League) to April 30, 1918.

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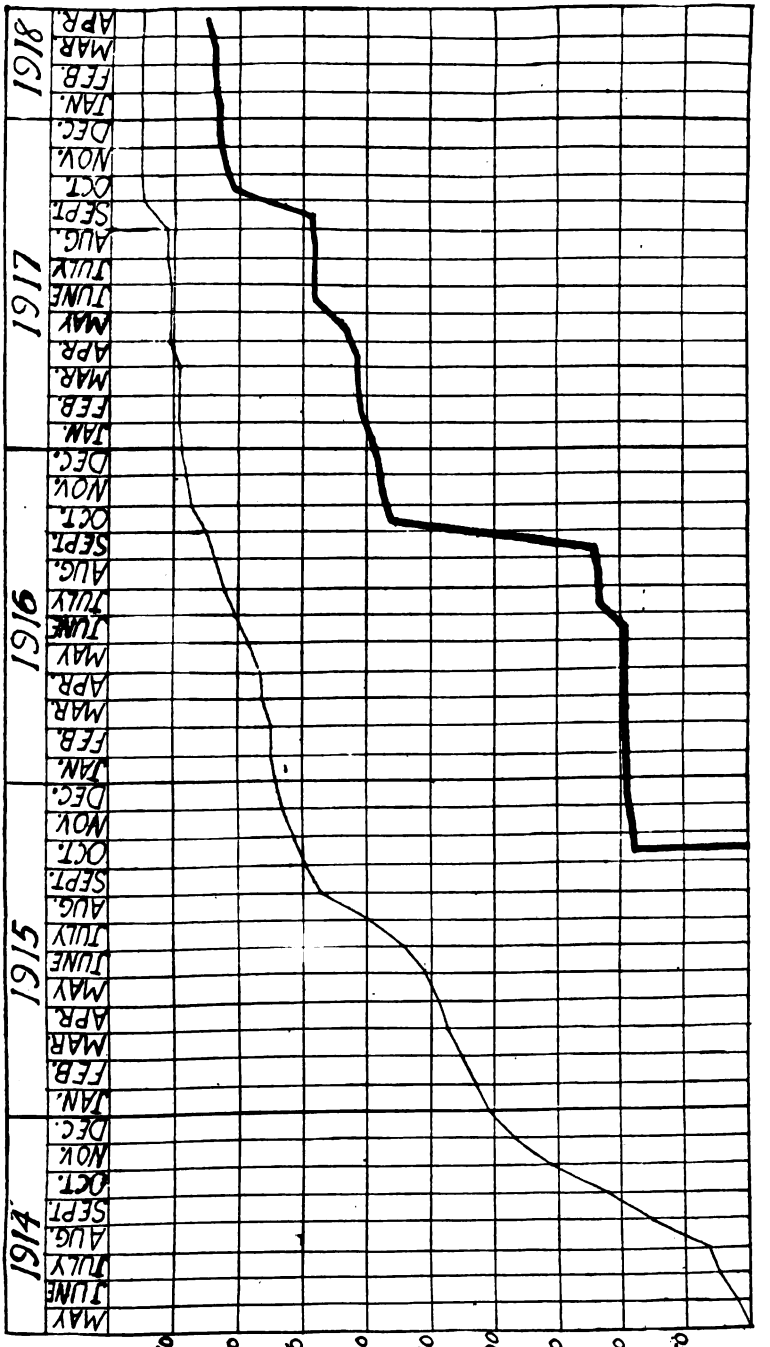

Fig. 2. Comparison of infected properties and properties declared no longer danger centers in Florida at different dates. The upper line shows the total number of canker-infected properties found in the State up to the end of any given month. The lower line shows the number of canker-infected properties declared by the Plant Board, up to corresponding dates, as being no longer danger centers. Complete to April 30, 1918.

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Certain actions taken by the Board in connection with violation of the rules and regulations governing the movement of nursery stock are treated of under the head of "Nursery Inspection" on a subsequent page of this report.

SUMMARY

Following are the essential facts concerning the eradication of citrus canker in Florida up to the close of the fiscal year April 30, 1918:

Total number of properties found infected in State	477
Total number declared no longer danger centers	426
Number still classed as active infections on April 30, 1918	51
Number of counties in which citrus canker has been found	22
Total number of grove trees found infected, May 1, 1914, to April 30, 1918	13,712
Total number of nursery trees found infected, May 1, 1914, to April 30, 1918	342,254
Total number of "exposed" grove trees destroyed, May 1, 1914, to April 30, 1918	233,720
Total number of "exposed" nursery trees destroyed May 1, 1914, to April 30, 1918	2,611,514
Amounts expended on canker eradication work in Florida:	
Prior to April 30, 1916:	
Federal funds	$ 56,428.97
State funds	111,342.34
From other sources	85,019.62*
Total	$252,790.93
May 1, 1916, to April 30, 1917 (see p. 37)	405,390.10†
May 1, 1917, to April 30, 1918 (see p. 41)	313,807.84‡
Grand total to April 30, 1918	$971,988.87

The following table shows the number of infected grove trees found in the State from the beginning of eradication work in May, 1914, to April 30, 1918***:

1914		1915		1916		1917		1918	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1
		Mar.	444	Mar.	49	Mar.	9	Mar.	1
		Apr.	408	Apr.	49	Apr.	169	Apr.	2
May	108	May	1042	May	338	May	52		
June	160	June	772	June	450	June	45		
July	275	July	651	July	349	July	89		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30		
Sept.	767	Sept.	618	Sept.	124	Sept.	6		
Oct.	565	Oct.	214	Oct.	451	Oct.	2		
Nov.	773	Nov.	494	Nov.	131	Nov.	1		
Dec.	366	Dec.	256	Dec.	27	Dec.	1		

*Includes donations and expenditures from private sources.
†Does not include donations, private expenditures or special salary increases provided by Acts of Congress.
‡For statement of infections May 1-October 31, 1918, see supplemental report (p. 90).

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NURSERY INSPECTION

The work of the Nursery Inspection Department has, under the efficient direction of Mr. F. M. O'Byrne, been continued during the biennium along the broad lines originally planned. The work of this Department is two-fold: to prevent the introduction of injurious insects and diseases through nursery stock shipped into the State, and to prevent the dissemination, on or with nursery stock, of pests and diseases already existing within the State. The success and value of the nursery inspection work is determined by the extent to which these objects are attained and it is worthy of note that no instance has yet come to light in which citrus canker has been distributed on nursery stock since the work of this Department was commenced.

For purposes of nursery inspection the State has been divided into thirteen districts. An assistant nursery inspector is assigned to each district, with headquarters therein, and is held responsible for the inspections and other official nursery inspection work in his district. County lines are not considered in forming these districts, the territory in each district being determined by the location of nurseries, available roads and other conditions permitting the most economical management of the work.

Fourteen assistant nursery inspectors are constantly employed, one in each of the thirteen districts and the remaining one assigned to office work, special investigations and emergency inspections. A list of the assistant nursery inspectors on duty April 30, 1918, will be found under the head of "Employees".

Certification may be refused a nursery for any of the following reasons:

Discovery of a new insect pest or disease in the nursery.

Superabundance of any common insect pest or disease.

Presence of an extremely injurious pest or disease.

Exposure of the stock to a highly infectious disease or dangerous insect pest.

Presence in the nursery of a serious pest not generally distributed in the State.

Condition of nursery stock such as to prevent a reliable inspection being made.

Quarantines are imposed upon nurseries when they have become infected with or exposed to extremely dangerous insects, pests, or diseases and, in some cases, when the nurseryman does

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not comply with the regulations of the Board in a manner insuring safety to his customers. A nursery refused certification or quarantined remains in that status until the dangerous condition has been removed or remedied. In no case is stock certified unless, in the light of all available information, it is safe for distribution and planting.

Nurseries found, upon inspection, to be in a satisfactory condition are certified by the Nursery Inspection Department as being apparently free from especially injurious insect pests and plant diseases. The Florida Plant Act requires that any nursery stock moved from the property on which grown shall have a copy of such certificate attached and anyone owning stock which has been certified may purchase certificate tags from the Nursery Inspector at the actual cost of printing. Printing of certificates by any person other than the Nursery Inspector is prohibited by law.

All certificate tags are serially numbered and the user is required to report the use of each tag by an invoice sent to the Nursery Inspector, this invoice showing the name and address of consignee, date of sale or shipment and the name and number of the trees or plants moved under the tag. The value of such a record has been repeatedly demonstrated. By means of these records, for example, infestations of the banana root borer have been located and the insect eradicated, and when a new avocado disease was discovered in several commercial nurseries, shipments from them were immediately followed up and inspected. Had such records of nursery stock movements been in existence at the time (1913-14) citrus canker was found in Florida, the cost of the campaign against this disease would have been reduced by at least a quarter of a million dollars.

The assistant nursery inspectors have continued their cooperation with the Department of Entomology in collecting colonies of the Vedalia, or Australian lady-bird beetle, for distribution to groves or neighborhoods where cottony cushion-scale occurs. During the biennium ending April 30, 1918, these inspectors collected a total of 2369 of these beneficial beetles and turned them over to the Entomologist.

As in previous years, all host plants of cottony cushion-scale in nurseries located in territory infested by this pest, have been required treated with a suitable insecticide, before shipment, under the directiion of an agent of the Plant Board. Agents employed for this purpose are known as "packing-house inspec-

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tors" and are paid only for actual time employed. A sum equal to their wages is collected by the Board from the nurserymen for whom service is rendered. The Plant Board incurs no expense by reason of their services. A list of the packing-house inspectors holding appointments at the end of the biennial period will be found under the head of "Employees".

The Nursery Inspector, in co-operation with the Plant Pathologist of the Experiment Station, has had under way for two years a field experiment to determine how citrus scab can be most effectively controlled under nursery conditions. While not yet completed the experiment shows striking results in that trees in the sprayed plots are now larger and more vigorous than those not treated and have been, thus far, free from any scab infection of importance.

Legal Actions

At the time of our last report warrants had been issued charging two parties with having moved nursery stock without a certificate of inspection attached, as required by the Plant Act. In both cases further action was suspended during compliance with the rules and regulations of the Board.

During the biennium, information has been filed against eight parties for violating the nursery inspection regulations. In one of these cases the grand jury failed to indict because it did not believe the violation had been committed with criminal intent; in one case prosecution was dropped on recommendation of the prosecuting attorney on account of ignorance, poverty and physical condition of the defendant, and in four cases the defendants plead guilty and were fined. Two cases are pending at the time of this report.

Summary of Work Done

During the two years San Jose scale was found in nurseries on 110 occasions. Shipments from infested blocks were in all cases immediately prohibited and the infestation at once cleaned up under the personal supervision of an assistant nursery inspector.

Camphor thrips was found in 10 nurseries and all shipments of camphor trees therefrom were prepared under direct supervision of an inspector in such way as to eliminate danger of their carrying the pest.

Foot-rot of citrus was found in 8 nurseries. Shipments there-

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from were prohibited until the disease had been apparently eradicated from the nursery.

Scaly bark was discovered in localities in 9 counties not previously known to be infected. In all instances the conditions clearly indicated that the disease had been introduced prior to the creation of the Plant Board. These and other known infected areas are described in the Public Notices of the Board with reference to Scaly Bark areas (see Circular 30). Investigations by the Nursery Inspector and his assistants have indicated that Scaly Bark can be transmitted by means of seed from fruit grown in infected groves.

Avocado scab was found in 13 nurseries. Certification was refused in each case, but shipment of trees which were apparently clean was permitted under package certificate after an inspector had personally supervised the selection, treatment and packing.

The banana root-borer was found in one nursery. All banana plants in this and adjacent properties were promptly destroyed with permission and approval of the owners and all other possible steps taken to eradicate the pest.

INSPECTIONS

Year Ending April 30, 1917

Total number of nurseries inspected during year	1503
Total number of inspections made	3427

The acreage in the 1503 nurseries inspected was, on April 30, 1917, as follows:

Citrus	2,081.2	acres
Plum	2.75	"
Pecan	489.25	"
Peach	6.5	"
Ornamental and general	256.	"
Total	2,835.7	"

The amount of stock (number of trees or plants) in the 1503 nurseries on April 30, 1917, was as follows:

Citrus—		
Budded grapefruit	1,744,147	
Budded oranges	3,320,414	
Other budded varieties	283,416	
Unbudded seedlings	12,896,089	
Total citrus stock		18,244,066
Citrus stock which could not be certified		2,178,484
Total marketable citrus stock		16,065,582

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Pecan—			
Budded	346,211		
Seedlings	431,919		
Total pecan stock		778,130	
Pecan stock which could not be certified		152,925	
Total marketable pecan stock			625,205
Peach—			
Budded	43,662		
Seedlings	54,763		
Total peach stock		98,425	
Peach stock which could not be certified		25,300	
Total marketable peach stock			73,125
Plum—			
Budded	10,600		
Seedlings	10,580		
Total plum stock		21,180	
Plum stock which could not be certified		650	
Total marketable plum stock			20,530
General and Ornamental—			
Total general and ornamental stock	6,484,336		
Stock which could not be certified	295,640		
Marketable general and ornamental stock		6,188,696	
Total marketable stock			22,973,138

Year Ending April 30, 1918

Total number of nurseries inspected during year..... 2075
Total number of inspections made..... 5780

The acreage in the nurseries under inspection was, on April 30, 1918, as follows:

Citrus	2,191.1	acres
Plum	5.9	"
Pecan	426.9	"
Peach	11.1	"
Avocado	15.25	"
Ornamental and general	306.	"
Total	2,950.25	"

The amount of stock in the nurseries on April 30, 1918, was as follows:

Citrus—			
Budded grapefruit	1,374,378		
Budded oranges	2,311,534		
Other budded varieties	480,610		
Unbudded seedlings	11,061,622		
Total citrus stock		15,228,144	
Citrus stock refused certification		2,211,392	
Total marketable citrus stock			13,016,752

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Pecan—			
Budded	766,050		
Unbudded seedlings	892,900		
Total pecan stock		1,658,950	
Pecan stock refused certification		27,500	
Total marketable pecan stock			1,631,450
Peach—			
Budded	37,700		
Unbudded seedlings	520		
Total peach stock		38,220	
Peach stock refused certification		700	
Total marketable peach stock			37,520
Plum—			
Budded	11,313		
Unbudded seedlings	16,000		
Total plum stock		27,313	
Plum stock refused certification		0	
Total marketable plum stock			27,313
Avocados—			
Budded	64,784		
Unbudded seedlings	129,566		
Total avocado stock		194,350	
Avocado stock refused certification		78,700	
Total marketable avocado stock			115,650
General and Ornamental—			
Total general and ornamental stock		4,764,457	
Stock refused certification		90,652	
Marketable general and ornamental stock			4,673,805
Total stock in Florida nurseries		21,911,434	
Total stock refused certification		2,408,944	
Total marketable stock in Florida nurseries			19,502,490

CERTIFICATES ISSUED

Certificate tags were issued as follows:

Form of Certificate	Total No. tags issued during fiscal year 1916-17		
Regular tags	81,100 to 351	nurseries and	individuals
Stock dealers' tags	8,300 to 27	"	"
Package tags	3,831 to 189	"	"
Scaly bark tags	9,950 to 122	"	"
Truckers' tags	6,700 to 76	"	"
Florida permit tags	35,012 to 185	"	"
Total	144,893	950	

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1917-18

Regular tags	55,576	to	329	nurseries and individuals
Package tags	2,648	to	112	" "
Stock dealers' tags	6,739	to	21	" "
Scaly bark tags	1,894	to	43	" "
Florida permit tags	19,643	to	184	" "
Truckers' tags	94	to	6	" "
Total	86,594		695	

Grand total of certificates issued for biennium..... 231,487

Certificates Refused

During the two fiscal years certificates were refused nurseries as shown below:

Cause	Number of Occasions	
1916-17		
San Jose scale	75	
California red scale	26	
Camphor thrips	9	
Excessive whitefly and scale	568	
Excessive citrus scab	11	
Scaly bark	13	
Dictyospermum scale	40	
Foot rot of citrus	16	
Red banded thrips	1	
Dieback of pecan	1	
Total		760
1917-18		
Avocado scab	52	
San Jose scale	35	
California red scale	47	
Camphor thrips	11	
Excessive whitefly and scale	895	
Excessive amount of citrus scab	1	
Dictyospermum scale	5	
Foot rot of citrus	10	
Red banded thrips	3	
Dieback of pecan	1	
Other causes	116	
Total		1184*

Quarantines

Quarantines were imposed upon nurseries as follows:

Cause	Number of Occasions
1916-17	
Citrus canker in nursery	0
Nursery in canker zone or being a "contact" property	122†
Other causes (pests of minor importance, etc.)	4

*This includes refusals for both commercial and non-commercial nurseries. Some nurseries are practically abandoned and are refused four times a year, once for each inspection made.

†Exclusive of Dade County.

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1917-18

Citrus canker in nursery	0
Nursery in canker zone or being a "contact" property	221*
Other causes	6

DEPARTMENT OF PORT AND RAILWAY INSPECTION

One of the principal objects in view in connection with the passage of the Florida Plant Act was protection of the State against the introduction of pests and diseases destructive to crops and fruits. To accomplish this purpose is the object of the Port and Railway Inspection Department of the Plant Board and its work is second in importance to none. Since its inception this work has been under the direct personal supervision of the Plant Commissioner.

During the past two years the Plant Board has become aware of new and increasing dangers from outside sources and as a result has added a considerable number of quarantine regulations, all of which require close inspection work by the Board's inspectors at all important ports of the State as well as at the principal railway centers. During the biennium the Board has greatly strengthened its quarantines against citrus canker and the black fly and has inaugurated quarantine measures against the pink bollworm of cotton. Other quarantines are mentioned on page 79.

In this Department only men of long experience and possessed of technical training can be utilized. All positions are filled by promotion from the Nursery Inspection Department. Many and frequent changes in the personnel of the inspection force have taken place during the past two years. This has been due in part to several of the men being called for military service; and the increased amount of shipping coupled with precautions made necessary on account of the war have made necessary the employment of more men in this work than formerly.

At the present time one Deputy Port and Railway Inspector is stationed at Pensacola, three at Jacksonville, two at Tampa, one at Miami, one at Key West and one at Gainesville, while two additional deputy inspectors, with headquarters at Gainesville, are assigned to special and emergency work.

Deputy inspectors board all vessels arriving at Florida ports and examine cargo, baggage, hand parcels of passengers, and the vessel itself for infected or contraband material. During the

*Dade County included.

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two years ending April 30, 1918, our inspectors boarded 7510 vessels, or an average of 313 per month. Shipments arriving on these vessels, to the number of 2822, were inspected. During the same period, 3705 express, freight and wagon shipments were inspected.* The value of this work is shown by the fact that out of the total of 6527 shipments examined, more than one-half were found to be either affected with injurious insects or diseases or were being shipped contrary to rules of the State Plant Board or Federal Horticultural Board and were therefore to be considered dangerous. All such shipments were either destroyed, deported or treated and passed, this in itself a task of magnitude.

All of the inspection work at the ports is done in cooperation with the Federal Horticultural Board, the Deputy Port and Railway Inspectors holding appointments as Collaborators of the Federal Horticultural Board. All expense of this work must be, however, borne by the State, the federal co-operation not extending beyond the granting of authority to the inspectors to enforce federal plant quarantine laws and rules.

In addition to inspectioin of vessels arriving at our ports, inspectors in this Department frequently inspect material being transported on river steamers, a vast amount of freight entering the State and a very considerable percentage of the express shipments from other states.

The tables following give all essential data regarding this work, together with a list of the insects and diseases intercepted and prevented from entering the State. A number of the interceptions made were of particular importance. For example, the black fly was twice prevented from entering Florida, material from the British West Indies infested with the sweet potato scarabee and many West Indian shipments containing the sweet potato weevil were stopped, as was also a shipment from India bearing a new mango disease and a new mango leaf-infesting insect. In a number of instances scale-insects which are of rare occurrence or lacking in Florida were prevented from entering. Sight should also not be lost of the fact that the existence of plant quarantine rules and their enforcement in Florida has prevented many shipments, now prohibited, that would otherwise have been made into the State, many of which would doubtless have conveyed dangerous pests and diseases.

*A "shipment" in many cases consisted of many packages, crates or parcels: hence the number of pieces inspected was much in excess of the number of shipments inspected.

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Report of Inspections During the Fiscal Year Ending April 30, 1917

Vessels Inspected:		
From foreign ports	1240	
From U. S. ports other than Florida	658	
From Florida ports	1359	
Total		3257
Shipments Inspected:		
Arriving by water:		
Passed	211	
Treated and passed	54	
Returned to shipper	111	
Detained, subject to return by shipper	25	
Contraband destroyed	1018	
Total		1419
Arriving by land—Express, freight, wagons, etc.:		
Passed	1103	
Treated and passed	188	
Returned to shipper	87	
Detained, subject to return by owner	144	
Contraband destroyed	164	
Total		1686
Total shipments inspected		3105

Principal Pests and Diseases Intercepted

Insect or disease	Occurring on	From	Number of Shipments Infested
Aphis sp.	Geranium	Florida	1
Aspidiotus britannicus	Laurel	Georgia	1
Bamboo borer	Bamboo	Louisiana	2
Birch scale	Birch	Maine	1
Black scale	Hibiscus	Florida	1
Black scale	Jessamine	Florida	1
Black scale	Poinsettia	Florida	1
Cactus scale	Cactus	Florida	1
California red scale	Oleander	Florida	1
Camphor thrips	Camphor	Florida	1
Chaff scale	Citrus	Florida	3
Chaff scale	Palm	Georgia	1
Chaff scale	Unknown shrub	Cuba	1
Chrysomphalus oleae	Palm	Georgia	1
Chrysomphalus sp.	Rose	Virginia	1
Cottony cushion-scale	Citrus	Florida	3
Cottony cushion-scale	Coleus	Florida	2
Cottony cushion-scale	Croton	Florida	1
Crown gall	Grape	Florida	1
Crown gall	Peach	Georgia	2
Crown gall	Peach	New York	1
Crown gall	Peach	Oklahoma	1
Crown gall	Pear	Missouri	1
Crown gall	Rose	Florida	1
Crown gall	Rose	Georgia	2
Crown gall	Rose	New York	1
Crown gall	Rose	Ohio	1
Crown gall	Rose	Pennsylvania	2
Crown gall	Rose	South Carolina	1
Diaspis sp.	Peach	Missouri	1

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Insect or disease	Occurring on	From	Number of Shipments Infested
Diaspis sp.	Plum	Missouri	1
Dictyospermum scale	Citrus	New York	2
Dictyospermum scale	Citrus	Spain	2
Dictyospermum scale	Plum	New Jersey	1
Dictyospermum scale	Palm	Pennsylvania	1
Fern scale	Fern	Georgia	1
Fiorinia fioriniae	Camellia	Maine	1
Florida red scale	Camphor	Florida	2
Florida red scale	Citrus	Florida	3
Florida red scale	Magnolia	Florida	1
Florida red scale	Mango	Florida	1
Florida red scale	Palm	Florida	1
Florida wax-scale	Citrus	Florida	1
Florida wax-scale	Mango	Florida	1
Florida wax-scale	Pear	Florida	1
Howard's scale	Gooseberry	Wisconsin	1
Long scale	Citrus	Florida	5
Mango scale	Mango	Florida	2
Mealy-bug	Citrus	Florida	1
Mealy-bug	Citrus	New York	1
Mealy-bug	Coleus	Michigan	1
Mealy-bug	Rose	Florida	1
Mealy-bug	Sugar Apple	Cuba	1
Mealy-bug	Unknown shrub	Cuba	1
Melanose	Citrus	Florida	2
Nematode root-knot	Alamanda	Florida	1
Nematode root-knot	Alamanda	Georgia	1
Nematode root-knot	Apple	North Carolina	1
Nematode root-knot	Australian Silk Oak	Florida	1
Nematode root-knot	Cassava	Florida	1
Nematode root-knot	Cherry	Georgia	1
Nematode root-knot	Chinese Medicine Plant	Florida	1
Nematode root-knot	Chrysanthemum	Florida	1
Nematode root-knot	Fig	Florida	11
Nematode root-knot	Fig	Georgia	10
Nematode root-knot	Fig	North Carolina	1
Nematode root-knot	Fig	South Carolina	7
Nematode root-knot	Fig	Texas	1
Nematode root-knot	Grape	Georgia	2
Nematode root-knot	Grape	New York	1
Nematode root-knot	Hibiscus	Florida	5
Nematode root-knot	Jessamine	Florida	1
Nematode root-knot	Laurel	Georgia	1
Nematode root-knot	Mulberry	Florida	2
Nematode root-knot	Papaya	Florida	1
Nematode root-knot	Peach	Florida	6
Nematode root-knot	Peach	Georgia	7
Nematode root-knot	Peach	Missouri	2
Nematode root-knot	Peach	Oklahoma	1
Nematode root-knot	Peach	South Carolina	1
Nematode root-knot	Pecan	Florida	1
Nematode root-knot	Plum	Florida	1
Nematode root-knot	Plum	Oklahoma	1
Nematode root-knot	Plumbago	Florida	3
Nematode root-knot	Poinsettia	Florida	1
Nematode root-knot	Rose	Georgia	1
Nematode root-knot	Rose	South Carolina	1

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Insect or disease	Occurring on	From	Number of Shipments Infested
Nematode root-knot	Rose	West Virginia	1
Nematode root-knot	Unknown shrub	Georgia	2
Nematode root-knot	Unknown plant	Florida	2
Oleander scale	Citrus	New York	2
Oyster-shell scale	Birch	Maine	1
Oyster-shell scale	Maple	Pennsylvania	1
Papaya fruit-fly	Papaya	Cuba	1
Papaya fruit-fly	Papaya	Florida	6
Peach scale	Peach	Florida	1
Peach tree borer	Peach	Georgia	1
Peach tree borer	Peach	Missouri	1
Peach tree borer	Peach	Tennessee	1
Peach tree borer	Plum	South Carolina	1
Phomopsis sp.	Mango	India	1
Purple scale	Citrus	Cuba	1
Purple scale	Citrus	Florida	19
Putnam's scale	Peach	Missouri	1
Putnam's scale	Plum	Missouri	1
Red spider	Rose	Cuba	3
Rufus scale	Tamarind	Cuba	1
Rufus scale	Unknown plant	Cuba	2
San Jose scale	Apple	Georgia	2
San Jose scale	Cherry	Georgia	1
San Jose scale	Cherry	Kentucky	1
San Jose scale	*Crataegus* sp.	North Carolina	1
San Jose scale	Currant	New Jersey	1
San Jose scale	Mulberry	Florida	1
San Jose scale	Peach	Florida	2
San Jose scale	Peach	Georgia	6
San Jose scale	Peach	Illinois	2
San Jose scale	Peach	Indiana	1
San Jose scale	Peach	Kentucky	1
San Jose scale	Peach	Missouri	1
San Jose scale	Peach	New Jersey	1
San Jose scale	Peach	South Carolina	1
San Jose scale	Pear	Florida	2
San Jose scale	Pear	Indiana	1
San Jose scale	Plum	Florida	2
San Jose scale	Plum	Georgia	4
San Jose scale	Plum	Illinois	1
San Jose scale	Plum	Missouri	1
San Jose scale	Poplar	Georgia	1
San Jose scale	Prune	Illinois	1
San Jose scale	Rose	Florida	1
San Jose scale	Rose	Georgia	1
San Jose scale	Unknown shrub	Georgia	1
Snow scale	Hibiscus	Florida	4
Snow scale	Soursop	Cuba	2
Snow scale	Soursop	Mexico	1
Snow scale	Unknown shrub	Florida	1
Soft brown scale	Citrus	Florida	1
Soft brown scale	Hibiscus	Florida	3
Soft brown scale	Laurel	Georgia	1
Strawberry leaf-roller	Strawberry	Wisconsin	1
Sugar-cane borer	Sugar-cane	Cuba	2
Turtle-back scale	Jessamine	Florida	1
Whitefly	Avocado	Florida	3
Whitefly	Citrus	Cuba	2

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Insect or Disease	Occurring on	From	Number shipments infested
Whitefly	Citrus	Florida	17
Whitefly	Coleus	Florida	1
Whitefly	Guava	Florida	2
Whitefly	Citrus	Honduras	1
Whitefly	Jessamine	Florida	4
Whitefly	Jessamine	Georgia	1
Whitefly	Privit	Florida	1
Whitefly	Privit	Georgia	1
Whitefly	Hibiscus	Florida	3
Withertip	Citrus	Cuba	2
Withertip	Citrus	Florida	1

Report of Inspections During the Fiscal Year Ending April 30, 1918

Vessels Inspected:		
From foreign ports	1777	
From U. S. ports other than Florida	982	
From Florida ports	1494	
Total		4253
Shipments Inspected:		
Arriving by water:		
Passed	302	
Treated and passed	22	
Returned to shipper	126	
Detained, subject to return by shipper	6	
Contraband destroyed	947	
Total		1403
Arriving by land—Express, freight, wagons, etc.:		
Passed	1077	
Treated and passed	77½	
Returned to shipper	359	
Detained, subject to return by shipper	415	
Contraband destroyed	90½	
Total		2019
Total shipments inspected		3422

Principal Pests and Diseases Intercepted

Insect or disease	Occurring on	From	Number of Shipments Infested
Aphis sp.	Chrysanthemum	Cuba	1
Aphis sp.	Hibiscus	Cuba	1
Aphis sp.	Rose	New York	1
Aspidiotus britannicus	Cocoa palm	Florida	1
Aspidiotus hederae	Chinaberry	Florida	1
Aspidiotus lataniae	Chinaberry	Florida	1
Aspidistra scale	*Anthurium* sp.	Illinois	1
Aspidistra scale	Unknown plant	Illinois	1
Bephrata cubensis	Soursop	Cuba	1
Black Scale	*Eugenia malaccensis*	Cuba	1
Black Scale	Gardenia	Pennsylvania	1

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Insect or disease	Occurring on	From	Number of Shipments Infested
Black Scale	*Hoffmannia* sp.	Illinois	1
Black Scale	Poinsettia	Cuba	1
Black Scale	Sago palm	Cuba	1
Boisduval's scale	*Billbergia* sp.	Illinois	1
Boisduval's scale	*Karatas princeps*	Illinois	1
Boisduval's scale	Palm	New York	1
Boisduval's scale	Unknown plant	Illinois	1
Cactus scale	Cactus	Cuba	1
Camphor thrips	Camphor	Florida	1
Cherry scale	Peach	South Carolina	1
Citrus scab	Citrus	Spain	1
Cloudy-winged white-fly	Citrus	Cuba	1
Corn weevil	Corn	Mexico	1
Chaff scale	Citrus	Cuba	2
Citrus mealy-bug	Guava	Florida	1
Coccus sp.	*Miconia magnifica*	Illinois	1
Cocoanut mealy-bug	Cassava	Cuba	1
Cocoanut mealy-bug	*Ochrocarpus africanus*	Cuba	1
Cocoanut mealy-bug	Palm	Cuba	1
Crown gall	Alva bush	North Carolina	1
Crown gall	Apple	Georgia	2
Crown gall	Currant	New York	1
Crown gall	Peach	Georgia	1
Crown gall	Peach	South Carolina	1
Crown gall	Plum	Ohio	1
Crown gall	Raspberry	New York	1
Crown gall	Rose	Cuba	1
Crown gall	Rose	Florida	2
Crown gall	Rose	New York	2
Crown gall	*Rubus* sp.	Iowa	1
Cyanophyllum scale	*Miconia magnifica*	Illinois	1
Cyanophyllum scale	Palm	Connecticut	1
Cyanophyllum scale	Palm	Cuba	1
Cyanophyllum scale	Palm	New York	1
Dictyospermum scale	*Acanthorhiza aculeata*	Illinois	1
Dictyospermum scale	*Anthurium* sp.	Illinois	1
Dictyospermum scale	Bahia	Cuba	1
Dictyospermum scale	*Billbergia* sp.	Illinois	1
Dictyospermum scale	*Eugenia malaccensis*	Cuba	1
Dictyospermum scale	Jessamine	Cuba	1
Dictyospermum scale	Mango	Florida	1
Dictyospermum scale	Palm	New York	2
Dictyospermum scale	Unknown plant	Illinois	1
Florida red scale	Citrus	Cuba	2
Florida red scale	Citrus	Florida	1
Florida red scale	Cocoa palm	Florida	1
Florida red scale	*Ficus* sp.	Florida	1
Florida red scale	*Ficus* sp.	Illinois	1
Florida red scale	Herbaceous plant	Florida	1
Florida red scale	Palm	Connecticut	1
Florida red scale	Palm	Cuba	1
Florida red scale	Palm	New York	1
Florida red scale	Rose	Cuba	1
Florida red scale	Rubber plant	Florida	1
Florida wax-scale	Ivy	Georgia	1
Greedy scale	Privet	Alabama	1
Greedy scale	Rose	Florida	1

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Insect or disease	Occurring on	From	Number of Shipments Infested
Green shield-scale	*Anthurium* sp.	Illinois	1
Hairy root	Euonymus	Alabama	1
Hemispherical scale	Sago palm	Cuba	1
Ivy scale	Ivy	Georgia	1
Latania scale	Pecan	Georgia	1
Latania scale	Sapodilla	Florida	1
Latania scale	Unknown plant	Cuba	1
Lesser snow scale	Bahia	Cuba	1
Lesser snow scale	Cassava	Cuba	1
Lesser snow scale	Mango	Florida	1
Lesser snow scale	Palm	Cuba	1
Long scale	Citrus	Cuba	3
Long scale	Citrus	Florida	2
Mango scale	Mango	Cuba	1
Mealy-bug	*Metrosideros floribunda*	Pennsylvania	1
Mealy-bug	*Miconia magnifica*	Illinois	1
Mealy-bug	Palm	Connecticut	1
Mealy-bug	Palm	Florida	1
Mealy-bug	Rose	Cuba	1
Mealy-bug	Sago palm	Cuba	1
Melanose	Citrus	Cuba	1
Melanose	Citrus	Florida	1
Mining scale	*Casuariva stricta*	Cuba	1
Mining scale	*Jacobina mohintli*	Cuba	1
Mulberry whitefly	Holly	North Carolina	1
Nematode root-knot	Fig	Alabama	1
Nematode root-knot	Fig	Cuba	1
Nematode root-knot	Fig	Florida	8
Nematode root-knot	Fig	Georgia	6
Nematode root-knot	Fig	South Carolina	1
Nematode root-knot	Grape	Florida	1
Nematode root-knot	Hibiscus	Alabama	1
Nematode root-knot	Japonica	Georgia	1
Nematode root-knot	Mulberry	Iowa	1
Nematode root-knot	Peach	Florida	2
Nematode root-knot	Peach	Georgia	2
Nematode root-knot	Peach	South Carolina	1
Nematode root-knot	Rose	Florida	3
Nematode root-knot	Rose	New York	1
Nematode root-knot	Spirea	Florida	1
Oleander scale	Brunfelsia	Cuba	1
Oleander scale	Japonica	Cuba	1
Oleander scale	Lantana	Cuba	1
Oleander scale	Mammee apple	Cuba	1
Oleander scale	*Ochrocarpus africanus*	Cuba	1
Oleander scale	Palm	Cuba	1
Oleander scale	Sago palm	Cuba	1
Orthezia insignis	Chrysanthemum	Cuba	1
Oyster-shell scale	Snowball	Pennsylvania	1
Oyster-shell scale	Willow	New York	1
Papaya fruit-fly	Papaya	Florida	1
Peach borer	Peach	Georgia	1
Perforated palm scale	Palm	Connecticut	1
Pineapple scale	*Billbergia* sp.	Illinois	1
Pineapple scale	Dracena	Illinois	1
Pineapple scale	Pineapple	Cuba	1
Purple scale	Citrus	Cuba	6

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Insect or disease	Occurring on	From	Number of Shipments Infested
Purple scale	Citrus	Florida	6
Purple scale	Mango	Florida	1
Putnam's scale	*Acer* sp.	Ohio	1
Putnam's scale	Apple	Ohio	1
Red bay scale	Unknown plant	Cuba	1
Rose scale	Raspberry	Iowa	1
Rose scale	Rose	Mississippi	1
Rose scale	Rose	New York	1
Rufous scale	Brunfelsia	Cuba	1
Rufous scale	Citrus	Cuba	3
Rufous scale	Croton	Cuba	1
Rufous scale	Pandanus	Cuba	1
San Jose scale	Apple	Georgia	2
San Jose scale	Apple	New York	1
San Jose scale	Cherry	Massachusetts	1
San Jose scale	Cherry	New York	1
San Jose scale	Cherry	Georgia	1
San Jose scale	Currant	Massachusetts	1
San Jose scale	Jasmine	Florida	1
San Jose scale	Lilac	Origin unknown	1
San Jose scale	Peach	Alabama	1
San Jose scale	Peach	Florida	2
San Jose scale	Peach	Georgia	4
San Jose scale	Peach	Massachusetts	1
San Jose scale	Peach	Michigan	1
San Jose scale	Peach	Ohio	1
San Jose scale	Peach	South Carolina	3
San Jose scale	Peach	Tennessee	1
San Jose scale	Pear	Georgia	4
San Jose scale	Pear	South Carolina	1
San Jose scale	Pecan	Florida	1
San Jose scale	Persimmon	Georgia	1
San Jose scale	Plum	Florida	2
San Jose scale	Plum	Georgia	4
San Jose scale	Plum	Kentucky	1
San Jose scale	Plum	North Carolina	1
San Jose scale	Plum	South Carolina	1
San Jose scale	Plum	Pennsylvania	2
San Jose scale	Rose	Florida	2
San Jose scale	Rose	Georgia	1
San Jose scale	Unknown plant	North Carolina	1
Snow scale	Citrus	Florida	1
Soft brown scale	Acalypha	Florida	1
Soft brown scale	Chrysanthemum	Florida	1
Soft brown scale	Guava	Florida	1
Soft brown scale	Ivy	Georgia	1
Soft brown scale	Lily	Florida	1
Soft brown scale	Maguey	Florida	1
Soft brown scale	Pseuderanthemum	Cuba	1
Soft scale	*Ficus* sp.	Illinois	1
Soft scale	*Pinanga* sp. (Palm)	Illinois	1
Spiny citrus whitefly	Citrus	Cuba	1
Sweet potato root weevil	Sweet potato	Cuba	9
Sweet potato scarabee	Sweet potato	St. Lucie, B.W.I.	1
Tree-hopper	Camphor	Florida	1
Walnut scale	Cherry	Indiana	1
Walnut scale	Cherry	Massachusetts	1

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Insect or disease	Occurring on	From	Number of Shipments Infested
Walnut scale	Grape	New York	1
Walnut scale	Peach	Florida	1
Walnut scale	Peach	Massachusetts	1
Walnut scale	Peach	New York	2
Walnut scale	Pear	New York	1
Walnut scale	Plum	New York	2
Walnut scale	Chinaberry	Florida	1
Whitefly	Citrus	Alabama	1
Whitefly	Citrus	Cuba	2
Whitefly	Citrus	Florida	8
Whitefly	Jasmine	Florida	8
Whitefly	Jasmine	Georgia	1
Whitefly	Jasmine	South Carolina	1
Whitefly	Privet	Alabama	1
Whitefly	Privet	South Carolina	1
White peach scale	Bahia	Cuba	1
Withertip	Citrus	Florida	1
Wooly apple aphis	Apple	Georgia	1

Parcel Post Inspection

Within a few months after its organization the Plant Board was able to practically put a stop to shipments of infested material into the State by freight or express. However, the mails still remained open to unscrupulous or careless people in other states as an avenue through which diseased trees and plants could be unloaded upon Florida citizens.

To meet this condition the Plant Board made application to the Postoffice Department for the privilege of inspecting mail shipments of plants and plant products, addressed to Florida postoffices, under the provisions of the Act of Congress of March 4, 1915, and embodied in Section 478¼, Postal Laws and Regulations. After considerable preliminary correspondence, most of which had to do with agreement on the classes of material to be made subject to inspection, the Third Assistant Postmaster General, on October 24, 1916, issued an order providing for the inspection, by agents of the Plant Board, of all trees, plants, shrubs, vines, cuttings and certain other plant materials consigned to Florida postoffices. Under this order parcel post material subject to inspection was required sent to the postoffice at Gainesville for inspection. Later, arrangements were made for similar inspections at the postoffices at Pensacola, Jacksonville and Tampa and inspection facilities are maintained at the four postoffices named at the present time. The orders, rules, etc., of the Postoffice Department, authorizing such in-

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spection, will be found in Circular 30 of the Plant Board.

As soon as inspection of mail matter was commenced it was found that large quantities of infested and diseased plants were being shipped into the State. Between November 1, 1916, when this inspection service was commenced, and April 30, 1917, 4138 mail shipments were inspected and of this number 579 were found undeliverable on account of plants in the shipments being infested or diseased. Also 72 parcels were treated and passed. During the twelve months ending April 30, 1918, 5045 parcels were similarly inspected, of which 266 were non-deliverable in the condition in which they were received because of containing dangerous insects or plant diseases. There were 220 treated and passed and the remainder returned to senders or destroyed.

The inspection of mail shipments has prevented the delivery to Florida citizens of many thousands of insect-ridden and diseased plants and, in final results, has prevented losses running into many thousands of dollars.

But one unfortunate feature has characterized this work and that has been the failure on the part of many postmasters to do their part by complying with the orders of the Postoffice Department in this matter. Through their negligence or indifference, many shipments have been delivered direct to Florida citizens when these shipments should have first been sent by the postmaster for inspection. As a partial remedy for this condition, your Plant Commissioner recommends that sufficient funds be made available for this work so that special representatives of the Plant Board may be assigned to the duty of keeping check on the postmasters who are negligent in this matter.

The following tables give the results of the parcel post inspection work for the biennium:

PARCEL POST PLANT INSPECTION

Fiscal Year Ending April 30, 1917

(Nov. 4, 1916, to April 30, 1917)

PARCELS INSPECTED:		
Passed	3487	
Treated and passed	72	
Returned to sender	552	
Detained, subject to return	13	
Infested or infected parcels destroyed	14	
Total Parcels Inspected		4138

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Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of parcels infested
Borer	Walnut	Georgia	1
Chaff scale	Citrus	Ohio	1
Crown gall	Apple	Nebraska	1
Crown gall	Rose	Ohio	18
Dictyospermum scale	Rubber	Ohio	1
Florida red scale	Citrus	Florida	1
Long scale	Citrus	Florida	1
Melanose	Citrus	Florida	1
Nematode root-knot	Begonia	Ohio	10
Nematode root-knot	*Cissus discolora*	Ohio	1
Nematode root-knot	Coleus	Ohio	2
Nematode root-knot	Chrysanthemum	Ohio	16
Nematode root-knot	Chrysanthemum	Florida	1
Nematode root-knot	Cyclamen	Ohio	1
Nematode root-knot	Daisy	Ohio	16
Nematode root-knot	Fig	Florida	4
Nematode root-knot	Geranium	Florida	1
Nematode root-knot	Geranium	Ohio	19
Nematode root-knot	Grape	Tennessee	1
Nematode root-knot	Hibiscus	Ohio	17
Nematode root-knot	Honeysuckle	Ohio	3
Nematode root-knot	Ivy	Ohio	1
Nematode root-knot	Lemon verbena	Ohio	2
Nematode root-knot	Primula obconica	Ohio	1
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Peony	Ohio	1
Nematode root-knot	Rose	Florida	2
Nematode root-knot	Rose	Georgia	1
Nematode root-knot	Rose	Indiana	1
Nematode root-knot	Rose	Ohio	511
Nematode root-knot	Rose	Pennsylvania	1
Nematode root-knot	Rose	North Carolina	1
Nematode root-knot	Salvia	Ohio	1
Nematode root-knot	Tomato	Florida	2
Nematode root-knot	Tomato	Georgia	1
Nematode root-knot	Violet	Ohio	1
Nematode root-knot	Wistaria	Ohio	1
Purple scale	Citrus	Florida	5
San Jose scale	Chinaberry	Florida	1
San Jose scale	Peach	Illinois	1
San Jose scale	Rose	Florida	1
Whitefly	Citrus	Florida	2
Whitefly	Citrus	Ohio	1

Fiscal Year Ending April 30, 1918

PARCELS INSPECTED:

Passed	4779	
Treated and passed	220	
Returned to sender	4	
Detained, subject to return by sender	27	
Infested or infected parcels destroyed	15	
Total Parcels Inspected		5045

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Pests Intercepted

Insect or Disease	Occurring on	From	Number shipments infested
Bruchus sp.	Cow peas	Florida	1
Citrus mealy-bug	Citrus	Pennsylvania	1
Citrus mealy-bug	Coleus	Ohio	6
Crown gall	Peach	Georgia	1
Crown gall	Rose	Illinois	1
Crown gall	Rose	Ohio	13
Dictyospermum scale	Palm	New Jersey	1
Florida red scale	Palm	New Jersey	1
Florida wax-scale	Ivy	New York	1
Ivy scale	Ivy	New York	1
Lace bug	Rhododendron	Tennessee	1
Mealy-bug	Coleus	Ohio	1
Mealy-bug	Hibiscus	Ohio	1
Mealy-bug	Rose	Ohio	1
Mealy-bug	Salvia	Ohio	1
Melanose	Citrus	Florida	1
Nematode root-knot	Begonia	Illinois	1
Nematode root-knot	Begonia	Ohio	6
Nematode root-knot	Canna	New York	1
Nematode root-knot	Chrysanthemum	Ohio	10
Nematode root-knot	*Clematis paniculata*	New York	1
Nematode root-knot	Coleus	Ohio	4
Nematode root-knot	Discorea	Illinois	1
Nematode root-knot	Fig	Florida	2
Nematode root-knot	Geranium	Florida	1
Nematode root-knot	Geranium	New York	1
Nematode root-knot	Geranium	Ohio	27
Nematode root-knot	Grape	Florida	1
Nematode root-knot	Grape	Pennsylvania	1
Nematode root-knot	Hibiscus	Ohio	9
Nematode root-knot	Kudzu vine	Ohio	1
Nematode root-knot	Lemon verbena	Ohio	4
Nematode root-knot	Lilac	Ohio	1
Nematode root-knot	Peach	Florida	1
Nematode root-knot	Petunia	Ohio	2
Nematode root-knot	Plum	Florida	1
Nematode root-knot	Plumbago	Ohio	1
Nematode root-knot	Rose	Florida	1
Nematode root-knot	Rose	Illinois	1
Nematode root-knot	Rose	New York	1
Nematode root-knot	Rose	Ohio	150
Nematode root-knot	Snowball	Ohio	1
Nematode root-knot	Tomato	Florida	2
Nematode root-knot	Unknown plant	Kentucky	1
Nematode root-knot	Unknown shrub	South Carolina	1
Nematode root-knot	Wistaria	Ohio	1
Oleander scale	Oleander	Ohio	1
Oyster-shell scale	Willow	New York	1
Rose scale	Raspberry	Iowa	1
San Jose scale	Peach	Kentucky	1
San Jose scale	Peach	Ohio	1
San Jose scale	Pear	Ohio	1
San Jose scale	Plum	Florida	1
San Jose scale	Plum	Ohio	1
San Jose scale	Rose	South Carolina	1
Soft brown scale	Ivy	New York	1
Whitefly	Citrus	Florida	1
Whitefly	Jasmine	Florida	1

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NEEDED LEGISLATION

While the Florida Plant Act of 1915 is very broad and while its provisions cover practically all situations likely to arise in connection with the Plant Board's work, experience has shown the desirability of amendments in two respects.

Cases have occurred where there has been some question as to the court in which criminal proceedings should be brought and some prosecuting attorneys have taken advantage of this to decline, or shift, the responsibility for making prosecutions.

Some difficulty has been experienced, particularly in the quarantine work, with parties attempting, through threats and abusive lauguage, to intimidate the Plant Board's agents and prevent their proper performance of duty. While the general statutes afford relief in the case of actual assault upon the inspectors, an adequate remedy is not at hand for dealing with attempts at intimidation.

Your Plant Commissioner accordingly recommends that legislation be requested providing:

(1) That prosecutions for violation of provisions of the Florida Plant Act of 1915, or for violation of the rules and regulations of the Plant Board, may be made in any county of the State affected by such violations, and

(2) A severe penalty for interfering with or intimidating any agent of the State Plant Board when engaged in the discharge of his official duties.

SWEET POTATO WEEVIL

In several counties of the State the sweet potato weevil has caused the abandonment of commercial cultivation of the sweet potato and has, in fact, made it well-nigh impossible for farmers to produce enough potatoes for their own use. All counties which are generally infested with this insect are importers, rather than exporters, of sweet potatoes.

As the normal sweet potato crop of Florida is between three and one-half and four million bushels annually*, and as the weevil is readily carried to new localities in either tubers or plants, the seriousness of the situation is at once apparent. Continued spread of the pest will ultimately mean that but few sweet potatoes will be grown in Florida.

The presence of this insect in southern Florida was known at

*The crop of 1915-16 was 3,859,107 bushels.

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the time the Plant Board was created in 1915, but the urgency of the citrus canker situation, coupled with the necessity for assembling and training a corps of inspectors, made it impossible to give the weevil problem immediate attention.

As soon as the work of eradicating citrus canker was well under way and it was seen that substantial headway was being made against the disease, attention was given, as far as the means of the Board permitted, to the sweet potato weevil situation.

Several reports of the insect's occurrence in Dade County were received during 1916 and reference was found in publications of the U. S. Department of Agriculture to its occurrence in Manatee County in earlier years.

In December, 1916, the entomologist of the Experiment Station, Mr. J. R. Watson, received specimens of the weevil from Mr. Wm. A. Dopson, of Sanderson, Baker County. Subsequent investigation by Mr. K. E. Bragdon, inspector for the Plant Board, showed the insect present in the neighborhood of Sanderson, Glen St. Mary and Macclenny, all in Baker County. Growers reported that the insect had been present for about three years. Damage to the sweet potato crop in 1916 was very severe, 30% to 50% of the crop being in many instances destroyed while still in the field and the remainder destroyed by the weevils after digging and storing in houses or banks.

In June, 1917, the weevil was found in Broward and Palm Beach Counties, in July and August in Lee, Monroe and St. Lucie Counties, and in October in Volusia County.

In October, 1917, an isolated infestation was found at Citrus Park, Hillsborough County, and as only a few farms were infested, an attempt was immediately made by the Board, in cooperation with the owners, to eradicate the pest at this point. Subsequent investigation showed that the insect had been brought to Citrus Park the year previous in roots of the seaside morning glory which were planted as ornamentals. It was found that these morning glory roots had been taken from a point on Tampa Bay where the morning glories were heavily infested with the weevil.

As the insect was known to be generally distributed through the West Indies and known to occur in Louisiana and Texas, the Plant Board, on July 23, 1917, adopted Rule 32, prohibiting the importation into Florida of sweet potato tubers and plants and morning glory roots and plants (with certain exceptions in the

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case of new varieties for propagation), as a means of preventing further introductions of the pest. At the same time a Public Notice was issued by the Board, defining the areas in Florida known to be infested and Rules 33 and 34, regulating the shipment of sweet potato and morning glory tubers and plants out of the infested areas, were adopted. These rules have been found very effective in checking the spread of the weevil and have been amended from time to time as occasion required. The Public Notice and the Rules referred to will be found in Circular 30. Similar rules and regulations were shortly afterwards adopted by the States of Alabama, Georgia and South Carolina.

In October, 1917, a rather full account of the sweet potato weevil, and the measures to be used in reducing its damage, was published in the Quarterly Bulletin of the Plant Board.

Federal Co-operation

On July 1, 1917, Dr. F. H. Chittenden, of the Bureau of Entomology, U. S. Department of Agriculture, and your Plant Commissioner held a conference regarding the situation and the conclusion reached that a campaign of control and eradication was not only feasible and practical but would result in very materially increasing the sweet potato crop of the Southern States. The matter was accordingly placed before the Honorable Secretary of Agriculture, with the result that $10,000 was set aside out of the sum allotted for the suppression of insects injurious to truck crops, available under the provisions of the Food Production Act, approved August 10, 1917, this sum to be used by the Bureau of Entomology in preliminary survey work and demonstration methods in the states where the weevil occurred. As a part of this program, Agent O. K. Courtney of the Bureau was sent to Florida in January, 1918, to co-operate with the Plant Board.

In April, 1918, additional funds having been made available for the Bureau, a field laboratory was established at Macclenny, Baker County, for the study of the weevil and for experiments in improving the methods of control.

Territory Infested

Through the fall, winter and spring months, inspections were made by the Bureau agents and by the Plant Board inspectors,

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with the result that the weevil is now known to occur in Baker, Volusia, Brevard, St. Lucie, Palm Beach, Broward, Dade, Monroe, Lee, DeSoto, Manatee, Hillsborough and Pinellas Counties. The infestations in nearly all cases were found to be of comparatively long standing. Parts of Georgia, Alabama and Mississippi have also been found infested.

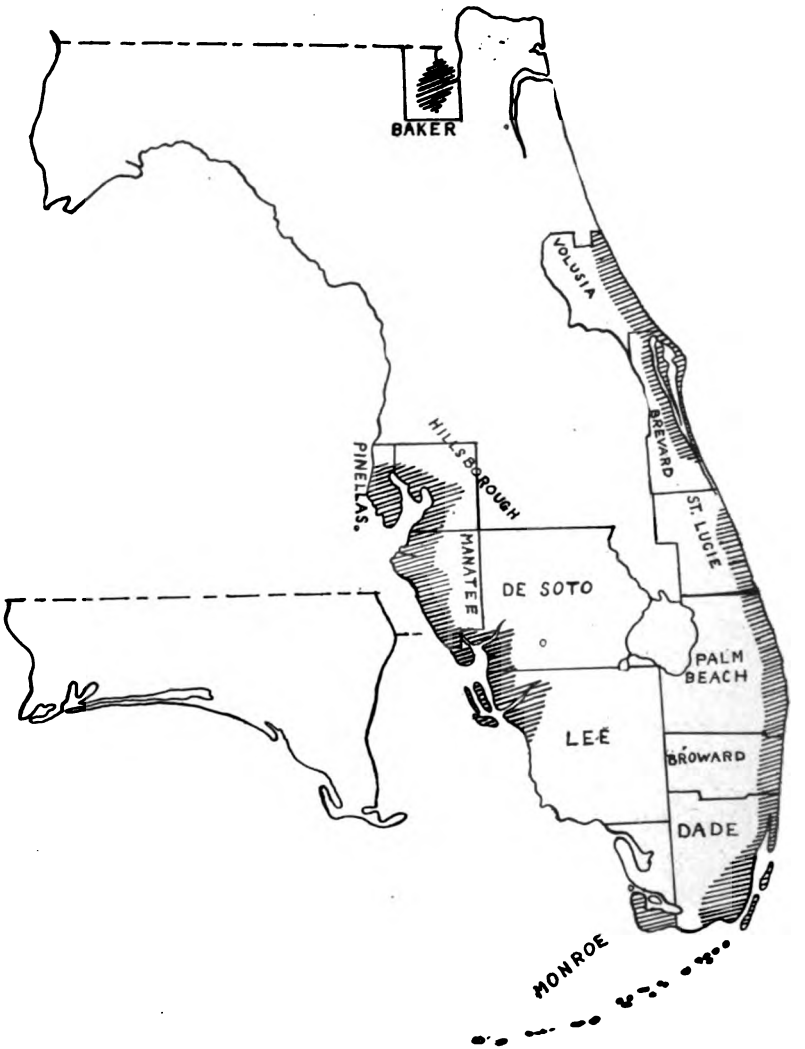

Fig. 3. Map of Florida showing areas at present known to be infested by the sweet potato weevil.

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Host Plants

The sweet potato plant is a close relative of the morning glory and it is therefore not surprising that the investigations of the past few months have shown that the insect breeds readily in the seaside morning glory *(Ipomoea pes-caprae)*, a small blue-flowered morning glory *(I. trifida)* and the moon-flower *(Calonyction aculeatum)*. In Mississippi it has also been found breeding in a closely related plant, *Ipomoea littoralis*. The seaside morning glory is of common occurrence along all of the sandy sea beaches of Florida, while the moon-flower occurs both along the coast and along lakes, canals, etc., in the interior.

This fact to some extent complicates the problems of control and eradication, for the occurrence of morning glory plants in or near infested fields must always be taken into consideration and dealt with as circumstances may require. For the same reason, all quarantines of the Plant Board applying to sweet potato tubers and plants apply also to morning glory roots and plants.

Plan of Campaign

The campaign against the sweet potato weevil, as now being carried on by the Bureau of Entomology and the State Plant Board, consists of three essential parts: preventing further spread of the weevil from areas already infested, control and eventual eradication of the weevil in the isolated infested area in Baker County and inspection of the plantings of growers who distribute sweet potato plants.

Preventing further spread of the weevil is accomplished mainly through the quarantine rules of the Plant Board, which prohibit tubers being shipped out of infested areas without first being fumigated, and the total prohibition of sweet potato plant shipments from infested localities.

In Baker County efforts are being made to personally instruct all farmers regarding the weevil and the measures by which damage from the insect can be reduced. The measures advocated at present consist of field rotation in planting, use of weevil-free plants, elimination of "hold-over" plantings, destruction of morning glory vines as far as practicable, thoroughness in harvesting, fumigation of harvested tubers, destruction of badly infested tubers, prevention of weevil damage in storage, destruction of volunteer plants in spring and avoidance of extremely early planting. It is hoped by these means to so greatly

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reduce the pest in Baker County that eventually eradication may be reached. In the meantime production of sweet potatoes in the infested area is being continued. The Baker County work is in reality an experiment upon a rather large scale to determine whether the insect can be eradicated and the production of sweet potatoes continued at the same time. The outcome of this experiment will doubtless determine whether eradication of the pest throughout the South generally should be undertaken.

Inspection of plantings in which sweet potato plants are grown for market has not been mandatory upon the plant growers and dealers but they have been quick to see the many advantages of furnishing weevil-free plants to their customers. During 1917, six growers applied for inspection and received certificates. During the spring of 1918 there were very few extensive plant growers in the State who did not request inspection. During this period 325 plantings were inspected, of which number 105 plantings were certified. Thirteen plantings were refused certification on account of the weevil being present in the plant beds or occurring in dangerous proximity thereto. Certificate tags to the number of 56,085 were issued for accompanying shipments of sweet potato plants. The sweet potato plant business of Florida is an important industry. The plant growers not only furnish many millions of plants to Florida farmers, but ship many millions more to states north of us where Florida-grown sweet potato plants are much in demand for the production of early crops. Sixty-six of the certified plant growers, during the season of 1918, made aggregate shipments of 34,940,200 sweet potato plants to customers in other states and, during the same season, sold 8,468,590 plants to Florida customers. The sweet potato plant business brings into Florida each year a sum of between $75,000.00 and $100,000.00. The continued shipment of plants into other states is entirely dependent upon continued close inspection, and certification, of the Florida plantings. In connection with these inspections every assistance possible was given the plant growers in keeping their plantings free from other destructive insects and from injurious sweet potato diseases.

The funds available to the Plant Board for this important work have been, unfortunately, very limited and the work could not have been carried on to the extent it has had it not been for the assistance rendered by the U. S. Department of Agriculture.

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SERIOUSNESS OF SITUATION

Inasmuch as the sweet potato weevil threatens to destroy the sweet potato growing industry of Florida, as well as the important industry of supplying many millions of sweet potato plants to the growers of other states, the campaign against this insect should be waged vigorously and upon a scale sufficiently large to permit of rapid progress being made. The resources available for this work thus far have permitted of little more than the quarantine and inspection work to prevent further spread. It has not been possible to take up control and eradication of the pest in but one of the thirteen Florida counties in which it occurs. The sweet potato crop is one of the most important in Florida, particularly from the standpoint of the average farmer, and money cannot be expended to better advantage than in controlling, subduing and eradicating the weevil. Your Plant Commissioner urges that the great importance of this matter be brought prominently to the attention of His Excellency, the Governor, and to members of the Legislature.

BANANA ROOT BORER

Section 5 of the Plant Act requires the Plant Board to "list the insect pests and diseases of which it shall find that the introduction into, or the dissemination within, this State should be prevented".

The Board, at its meeting on February 14, 1916, having knowledge of the occurrence of a destructive banana pest in the West Indies, known as the banana root borer*, by resolution, declared this insect and all plants infested with it to be public nuisances, though the insect was not at that time known to occur within the State.

In December, 1917, a gentleman owning a banana planting near Larkins, Dade County, noticed severe injury to his plants and, finding an insect in the stems, took specimens of it to the Plant Introduction Gardens at Miami. Here it was examined by Mr. G. F. Moznette and by him sent to the Federal Horticultural Board at Washington. Mr. E. R. Sasscer, Entomological Inspector for the Horticultural Board on January 5, 1918, wrote the Plant Commissioner that the specimens had been identified as being the banana root borer.

Steps were immediately taken to determine the extent of the

**Cosmopolites sordidus.*

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infested area and between January 5th and 19th inspection was made by Plant Board inspectors of 34 banana plantings, comprising 10,129 plants, in and around Larkins. Ten properties, containing 977 plants, were found infested, the actual number of infested plants being 367. The owners of these were only too ready to co-operate in eradicating the pest and the eradication work was immediately commenced. This consisted of uprooting and burning all banana plants in the infested properties, the plants being burned with the aid of large quantities of wood and oil. As it was realized that some of the insects would remain in the ground and others escape in the course of destroying the infested plants, a plan for trapping any such was devised. This consisted, at first, of planting young, healthy banana plants in the properties following destruction of the infested plants. It was found, however, that the young plants were not very attractive to the adult weevils, and as a result of observations by Mr. Paul M. Hoenshel, Assistant District Inspector, sections of banana stems were tried. Non-infested stems were cut into sections about a foot long and then split lengthwise and these laid on the ground with the flat surface downward. These were examined by the inspectors weekly and weevils found on or in them were collected and killed. The traps themselves were replaced with new ones at intervals of two weeks to prevent the possibility of any weevils maturing in them. This trapping was continued as long as weevils were being captured.

Inquiry into the history of the infested plantings at Larkins showed that the fields had been planted exclusively with plants purchased from a north Florida nursery in the spring of 1914, and that the latter nursery had, in turn, secured the plants from a south Florida nursery. Inspections of the banana plants in the latter nursery were made as soon (February, 1918) as this information was brought to light, but no specimens of the root borer were found until March 18, 1918. As soon as this discovery was made the owners of the nursery exerted every effort to assist us in eradicating the pest from their premises by proceeding at once to destroy all banana plants under direction of Plant Board inspectors. Traps to catch any weevils escaping the general cleaning-up process are at present in use in this property. A list of all parties to whom this nursery shipped banana plants during the past four years has also been obtained and investigations will be made to determine whether any of the plantings made from these are infested.

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The investigations have recently brought to light an area of infestation by this insect in Manatee County and at the expiration of this report, April 30, 1918, the extent of this infested area is as yet undetermined. (See Supplemental Report, p. 95.)

It is of the utmost importance that every occurrence of this insect in Florida be located and the pest completely eradicated, particularly as the insect also attacks sugar cane and it is not impossible that its future presence in the State might seriously interfere with the development of a large sugar and syrup producing industry.

THE BLACK FLY

In our last report mention was made of the occurrence of the black fly, or "spiny citrus whitefly" in The Bahamas, Jamaica and Cuba and of the very destructive nature of this pest as determined by our Dr. J. H. Montgomery on his trip of investigation to Nassau in May, 1916.

During the past two years the danger of this insect being introduced into Florida has steadily increased although, fortunately, our Port and Railway Inspection Department, operating under the provisions of Rule 26, adopted by the Plant Board June 5, 1916, and amended November 12, 1917, has apparently been successful in thus far intercepting or preventing entry of all infested shipments and the insect is not yet known to have become established in the State.

The black fly must be regarded as a pest as much to be dreaded as citrus canker and there can be little doubt but what, if it becomes established in Florida, large sums of money will have to be expended in its eradication. It does not, however, confine its attacks to citrus trees but is also an enemy of the avocado, guava, pomegranate, papaya, plantain and other fruits.

Because of the heavy commerce between Florida and Cuba the black fly situation in the latter country is of great importance. Havana is less than one day's journey by boat from Key West and but two days' journey from Port Tampa.

THE SITUATION IN CUBA

Our first knowledge of the black fly occurring in Cuba was contained in a letter from Prof. John R. Johnston, Chief of the Comision de Sanidad Vegetal at Havana, dated May 31, 1916, sent in reply to our inquiry, advising that the insect had been

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found near Guantanamo in August, 1915, and that a subsequent survey had shown the infested area to be about two miles in diameter, in which citrus, mango, coffee and guava were affected. Efforts were made by the Cuban Government to eradicate this outbreak but local disturbances of a revolutionary nature later made necessary the abandonment of the work.

In December, 1916, the insect was found in the Vedado, a suburb of Havana, and by the following spring had infested many other suburbs of Havana and appeared at Hoyo Colorado, a point in Havana Province about 60 miles distant from Havana.

In August, 1917, Mr. Harold Morrison, of the Federal Horticultural Board, found the insect at both ends of the Panama Canal Zone.

In October, 1917, your Plant Commissioner, acting under instructions of the Plant Board, proceeded to Havana for the purpose of securing more information regarding the black fly, urging greater activity in Cuba towards subduing the pest and arranging for such co-operation with the Cuban Government as would tend to reduce the chances of the black fly being brought to Florida in shipments or by travelers. The writer held conferences with Professor Johnston and his immediate superior, Dr. Eugenio Agramonte, Secretary of Agriculture, Commerce and Labor, under direction of whose department the fight against the black fly was being carried on. The writer found the black fly to be fully as serious as previous reports had indicated and soon became convinced that the establishment of this pest in Florida would be little short of a calamity. A careful study was also made of the transportation system of Havana and vicinity and its bearing upon the possibility of black flies being transported to Florida in cars or vessels.

On the writer's return to Florida he submitted to the Plant Board a rather full report on his findings and the Board, on November 12, 1917, made broad amendments to its Rule 26 for the purpose of still further safeguarding the State against this pest and, at the same time, specifying the procedure to be followed if, at some future time, the insect should be found in Florida. This rule will be found in Circular 30 of the Plant Board. Under this rule the importation into Florida of all nursery stock, plants, foliage, etc., from black fly infested countries is prohibited and all fruits and vegetables arriving from such countries, as well as the baggage of all passengers, undergo

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a rigid inspection at the ports of entry by inspectors of the Plant Board.

In November, 1917, the Cuban Congress, at the direct request of President Menocal, appropriated $50,000.00 for the fight against the black fly. Under this appropriation and under authority of the decrees issued by the President, the Office of Plant Sanitation waged an active campaign against the pest in Havana during the winter and spring months following. In this work the advice and assistance of your Plant Commissioner and his assistants was requested and, accordingly, General Inspector Frank Stirling spent January 5 to 19, 1918, in Havana, acting in an advisory capacity and giving Professor Johnston suggestions based upon the Plant Board's experience in dealing with the citrus canker situation in Florida, the two problems being not unlike in many phases of the inspection and field work. At this time the Office of Plant Sanitation expressed a desire to avail itself of the services of two experienced inspectors from Florida and accordingly Assistant Nursery Inspector L. Russell Warner and Assistant District Inspector H. D. Bollinger were granted leaves of absence by the Plant Board and entered the employ of the Office of Plant Sanitation at Havana in February, 1918. At the present time both are still there, Mr. Bollinger assisting in the organization and management of the field inspection work and Mr. Warner in the nursery inspection work.

From November, 1917, to April, 1918, a vigorous campaign was waged against the black fly in Havana and its suburbs by the Office of Plant Sanitation, and as a result of the spraying and pruning of infested trees the insect was very materially reduced in numbers. To a considerable extent, also, host plants of the fly were removed from the railroad rights of way in the infested district, thus reducing the chances of adult black flies being transported to Florida in freight cars carried on the ferry to Key West.

In the meantime, however, no steps of consequence were taken to control the infestation at Guantanamo. The black fly appeared at additional points in Havana Province, and was found at twenty-three places in Santiago de Cuba Province, including the city of Santiago de Cuba. The infestation in the latter city is particularly severe.

On the whole, therefore, it cannot be said that the situation is any less threatening, so far as the danger of introducing the pest into Florida is concerned, than it was a year ago.

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The black fly has on two occasions been discovered by Plant Board inspectors in material arriving from Cuba. On one occasion a passenger from Havana was found, on her arrival at Key West, to have a cluster of grapefruit, leaves and twigs in which infested leaves were found. In the other case a commercial shipment arriving at Port Tampa was found to contain material infested with the black fly. These instances serve to show the actual danger existing and it is safe to conclude that, but for the vigilance of Plant Board inspectors, this dread pest would already be established in Florida.

BOLL WEEVIL QUARANTINE

In our last report we called attention to the well-known fact that the boll weevil has two methods of dissemination, one by natural flight or migration and the other by transportation in cotton seed, hulls, Spanish moss, etc. Migration or spread by flight cannot be prevented and each year results in the insect invading new territory. Distribution by means of cotton seed, moss and certain other articles *can* be prevented by suitable quarantine measures.

In the fall of 1915 the eastern limit of the boll weevil infested area in Florida passed through Hamilton, Madison and Taylor Counties. During the summer and autumn of 1916, the insect, by means of its annual migratory flight, infested additional territory to the east and south, the eastern limit of the infested territory in November, 1916, running through Nassau, Duval, Clay, Bradford and Levy Counties. Again in the summer and fall of 1917, the weevil extended its range, the southern limit of infestation in December, 1917, passing through Volusia, Lake, Sumter and Citrus Counties.

The Plant Commissioner's staff has continued to enforce the provisions of Rule 18 of the Plant Board, which prohibits the shipment, from weevil-infested territory, of cotton seed, cotton seed hulls, Spanish moss, corn in shuck, and certain other materials, to weevil-free areas except at such seasons and under such conditions as permit of the shipments being made without danger of transporting living boll weevils. Provision has been made for the shipment of cotton seed for planting purposes, from the weevil area to the weevil-free area, after such seed has been fumigated by the Entomological Department of the Board. During the season of 1917-18, the Entomologist fumigated a

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total of 2006 bushels of cotton seed which were sent to south Florida for planting.

These precautions have undoubtedly prevented the weevil establishing itself in many localities ahead of the advancing line of migrating weevils, and such localities have enjoyed immunity from the pest for from one to three seasons longer than would have been the case had such quarantine measures not been in effect.

PINK BOLLWORM QUARANTINE

The pink bollworm, a destructive cotton insect, was apparently introduced into Mexico in 1911 in a shipment of cotton seed from Egypt to Monterey and was introduced into the Laguna cotton growing region of Mexico the following year in shipments of seed from the infested Monterey section. However, these facts did not become known to the authorities in the United States until in November, 1916.

In the meantime, during 1916, shipments of Mexican cotton seed to the amount of more than 500 carloads had been sent to cotton oil mills in Texas. As soon as the presence of the pink bollworm in Mexico became known the Federal Horticultural Board, U. S. Department of Agriculture, prohibited the further importation of Mexican seed, expedited the crushing of all Mexican seed at the Texas mills and began active inspection of cotton fields in the vicinity of all the mills which had received seed from Mexico. These inspections brought to light two localities in Texas infested with the pink bollworm. One of these was found at Hearne, in September, and the other at Beaumont in October, 1917. All cotton plants in the infested fields and those adjoining were uprooted and burned and all vestiges of cotton destroyed. Over seven thousand acres were treated in this way.

Later in 1917 infested areas were found on Galveston Bay and Trinity Bay, south and southeast of Houston, Texas. The presence of the insect in this area is attributed to the fact that in August, 1915, several thousand bales of Mexican cotton were on the docks at Galveston when the severe storm of that month occurred and carried many of these bales to the mainland, broke them open and scattered the contents over many thousands of acres along Galveston and Trinity Bays. This cotton undoubtedly contained much seed which in turn contained larvae of the pink bollworm.

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A special act was passed by the Texas Legislature providing for the destruction of all cotton in infested areas and prohibiting the planting of cotton in such areas for a period of three years. In co-operation with the Federal Horticultural Board, the Texas State Department of Agriculture proceeded to destroy all cotton in the infested area south of Houston. This area was found to be about 50 miles wide by 150 miles long and covered all or parts of seven counties. The actual cotton in this area in 1917 was 3,829 acres.

Realizing that the infestation in south Texas was severe and widespread and knowing that cotton and seed had been shipped out of the infested Texas area in 1915 and 1916, thus giving rise to the possibility of centers of infestation as yet undiscovered, the Plant Board, on December 10, 1917, adopted its Rule 37, prohibiting the importation into Florida, from all states west of the Mississippi River, of all cotton lint, linters, waste, waste cotton and similar products.

The menace to the cotton industry was considered so serious that a conference of the quarantine officials of the cotton growing states was held at Houston, Texas, on January 18, 19, 1918. This conference was attended by your Plant Commissioner, acting under instructions from your Board, and a full report thereon submitted to the Plant Board on January 31, 1918.

The destructiveness of the pink bollworm to cotton under conditions existing in the Southern States may be gathered from the fact that in fifty pounds of mature bolls gathered at Smith Point, Texas, 1300 living pink bollworms were found. In this vicinity, in the fall of 1917, the insect destroyed forty per cent of the cotton bolls.*

Whereas the boll weevil flourishes and reaches its maximum of destructiveness in damp or rainy weather, the pink bollworm increases most rapidly in dry seasons and therefore reaches maximum destructiveness under those conditions which are unfavorable to the boll weevil. There can be no doubt but what the presence of both these destructive cotton pests in Florida would make the production of cotton impossible. The quarantine measures which the State Plant Board now has in effect for the purpose of excluding the pink bollworm should by all means be continued, particularly as co-operation of cotton planters, in the infested area of southern Texas, with the State and Federal

*A comprehensive account of the pink bollworm, by W. D. Hunter, of the Federal Horticultural Board, was published in the April, 1918, issue of the Plant Board's Quarterly Bulletin.

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officials, has not been unanimous and it is not yet certain by any means that the Texas outbreaks will be eradicated.

OTHER QUARANTINES

The Plant Commissioner has continued to enforce the various quarantine measures adopted by the Board for the purpose of preventing the introduction into Florida of the avocado weevil, banana wilt disease, brown rot of lemons and oranges, gypsy and brown-tail moths, citrus knot, cocoanut bud-rot, Mediterranean fruit fly, Mexican orange maggot, pineapple black weevil, West Indian sweet potato weevil, mango seed weevil and Argentine ant. In addition the inspectors in the Port and Railway work are ever on the alert for new or unknown insect pests which may be contained in importations.

DEPARTMENT OF ENTOMOLOGY

During the biennium the work of this Department has progressed very satisfactorily under the direction of Dr. E. W. Berger, Entomologist.

One assistant entomologist has been provided for by the Board. At the time of our last report this position was held by Mr. C. E. Wilson. Later he was succeeded by Mr. F. F. Bibby. After both Messrs. Wilson and Bibby entered the military service of the United States, Mr. Geo. B. Merrill was detailed from the Port and Railway Inspection Department to assist the Entomologist.

The amount of work accomplished in this Department, with a staff of but two men, is most creditable. The Department has been, and is, prosecuting six important lines of work, namely, growth and distribution of the red whitefly fungus for control of the whitefly, distribution of Australian lady-bird beetles for control of the cottony cushion-scale, investigations in the control of the camphor thrips, identification of insects in connection with the port and railway and nursery inspections and for growers, the giving of advice, through correspondence or personal visits, for the control of insect outbreaks and the keeping of records and specimens in connection with the distribution and prevalence of injurious insects within the State.

RED WHITEFLY FUNGUS

This fungus disease attacks the larvae of the citrus whitefly, destroying the latter. Its value is well-known to Florida

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citrus growers. Formerly the fungus was introduced in groves by means of fungus-bearing leaves taken from groves where this beneficial disease occurred. As this practice also involved the danger of disseminating injurious diseases, such as scaly bark, citrus canker, etc., the Plant Board in 1915 began advocating the use of pure cultures of the fungus, prepared in the Entomologist's laboratory, in lieu of fungus-covered leaves. The demand for these cultures, which are sold by the Plant Board at a price barely sufficient to cover the cost of the material used in their preparation, has increased each year and has been greater than the Department could supply with the facilities available.

During the fiscal year ending April 30, 1917, 328 of these cultures, sufficient to inoculate the whitefly in 328 acres of grove, were sold. During the fiscal year ending April 30, 1918, 757 of the cultures were sold.

Experiments have also been made by the Entomologist looking to securing a higher percentage of "fruiting", or usable cultures, through the control of temperature and other conditions. Considerable progress has been made.

Another whitefly fungus, known as the yellow Aschersonia, is useful in controlling the cloudy-winged whitefly and can also be prepared in the form of laboratory cultures. A considerable number of cultures of this fungus were also prepared by the Entomologist and furnished to growers in sections where the cloudy-winged whitefly is prevalent.

Australian Lady-Bird Beetles

The Vedalia, or Australian lady-bird beetle, is most efficient in controlling the cottony cushion-scale. From time to time the latter pest is found in new localities, making immediate introduction of the lady-bird beetle imperative. In localities infested with cottony cushion-scale the latter, through activities of the lady-bird beetles, often become so reduced in numbers that the beetles also become extinct, or nearly so, and in this case re-introduction of the lady-bird beetles becomes necessary.

The Entomological Department has continued its work of collecting colonies of the Vedalia and distributing them to growers. A nominal charge of $1.00 per colony of 12 to 15 beetles is made to cover expense of collection and distribution. Prior to the Plant Board engaging in this work, these beetles were not infrequently sold by private collectors at from $6.00 to $10.00 per dozen.

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After considerable experimentation the Entomologist and his assistants have found that, within certain limits, the lady-bird beetles can be reared in the laboratory by feeding them upon cottony cushion-scale. To accomplish this large supplies of the scale must be collected and kept in cold storage over considerable periods in order that a constant supply of food may be available for the Vedalia larvae. It has also been found that, in the temporary absence of scale, the young beetles can themselves be placed in cold storage and their development arrested pending the arrival of their next consignment of food. By following this method, supplemented by collections of lady-bird beetles by representatives of the Department and by assistant nursery inspectors, the Department has been able to meet practically all requests for the Vedalia.

During the fiscal year ending April 30, 1917, 72 colonies were furnished to Florida growers and 100 colonies to the Cottony Cushion-scale Commission of New Orleans, La., for control of a severe outbreak of the cottony-cushion scale in that city.

During the second fiscal year, 193 colonies, comprising 2400 lady-bird beetles, were distributed in Florida.

Camphor Thrips

The experiments, intended to provide an efficient treatment to free young camphor trees from the camphor thrips, mentioned in our last biennial report, were continued. Camphor trees infested by the thrips, treated with various insecticides and planted in isolated localities, did not afterwards show infestation. However, the cold weather of February, 1917, severely injured many of these trees, making interpretation of the results, so far as effect of the insecticide on the trees was concerned, rather difficult. However, the Entomologist has been able, from the experience obtained, to develop a combined method of cutting back and treating of infested trees which renders them free from infestation. This method is now being used in camphor tree nurseries for treatment, under supervision of the Nursery Inspector, of infested trees prior to the latter being sold or shipped.

Identification of Insects

Both the nursery inspectors and those engaged in the inspection of plant importations encounter many insects which cannot be identified except in the laboratory and by specialists. Such

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work falls to the lot of the Entomological Department and is of the utmost importance, for upon its accuracy depends in large degree the success of the Plant Board's nursery inspection and quarantine work. Farmers and fruit growers also submit many specimens, the identification of which is necessary in order that owners of infested groves or crops may be advised as to the proper measure for control.

During the first year of the biennial period 612 identifications were made. These insects were from 119 host plants and came from 128 different localities.

During the second year 2593 specimens of insects were received at the Department, all of which were identified with the exception of a few extremely rare or new species which were referred to other specialists.

Other Work

In connection with the Plant Board's quarantine to restrict the spread of the cotton boll weevil, the Entomological Department has fumigated cotton seed for planting in weevil-free sections of the State. During the year ending April 30, 1917, 1662 bushels were thus treated and during the second year 2006 bushels.

A large number of letters requesting advice regarding the control of various injurious insects are answered by the Entomologist and in the case of severe outbreaks of such pests personal aid and instruction is not infrequently given.

The Department is also engaged in keeping records regarding the occurrence of insects in different parts of Florida, together with specimens, these records forming a valuable and important source of information in connection with many practical problems arising from time to time.

In view of the steady increase in the demands made upon this Department and the necessity of still further enlarging the facilities for supplying the red whitefly fungus and Australian lady-bird beetles, your Plant Commissioner recommends that an additional assistant be provided for the Entomologist at the earliest date possible.

DEPARTMENT OF PLANT PATHOLOGY

Our last report recounted the establishment, at Redland, Dade County, in co-operation with the South Dade County Fruit Growers' and Truckers' Association, of the "Tropical Labora-

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tory" for the purpose of making careful investigations of citrus canker and methods for its cure or eradication. Work was continued at the laboratory under the direction of Dr. R. A. Jehle, Assistant Plant Pathologist of the Board, until November, 1917, at which time the laboratory was discontinued for reasons given below.

The most careful investigations of the character and nature of citrus canker, coupled with practical tests of various "remedies" or "cures" proposed by others, showed conclusively that there is no remedy for this disease other than prompt and complete destruction of the infected trees, coupled with rigid disinfecting and antiseptic measures.

Extensive experiments were made by Doctor Jehle to ascertain whether any non-citrus plants might be susceptible to citrus canker. Practically all cultivated and native trees and ornamental plants commonly found in south Florida were subjected to inoculation tests, this work being carried on in a well-screened, locked cage specially built for the citrus canker experiments.* Only one non-citrus plant, the so-called "wild lime", *Zanthoxylum fagara,* was found susceptible to the disease. Pin-prick inoculations in leaves of the wild lime resulted in typical citrus canker spots being produced and bacteria from these spots, in turn, produced typical citrus canker on grapefruit leaves. However, the discovery of one non-citrus host plant of the disease did not add any serious complication to the problem of eradication. Upon this discovery being made, inspections by the field force were extended to include all wild limes, but in no case has citrus canker been found upon the wild lime growing at large.

Very extensive experiments were made in the testing of various disinfectants on the citrus canker organism. The object of these was two-fold: first, to find a cheaper and better disinfectant for sterilization of clothing, tools, etc., and, secondly, to prevent serious interruption of the canker eradication work in case of any shortage, during the war, of the standard material, corrosive sublimate, generally used for this purpose. These experiments showed that a number of substitutes could be successfully used, but that under ordinary conditions, all things considered, the use of a corrosive sublimate solution, 1:1000, was the most effective and economical.

*An illustration of this cage will be found in the Quarterly Bulletin, Vol. I, No. 2, pp. 25 and 28.

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Much of Doctor Jehle's time was devoted to testing various treatments and supposed "cures" for citrus canker, suggested or proposed by various parties. Without exception, all such methods or preparations were found worthless for the purpose intended.

Not the least in importance of the work done at the laboratory was the making of laboratory examinations and tests of canker infections found by the inspectors in their field work, particularly in Dade County. In some few instances the identity of doubtful infections could not be clearly established until after such tests.

Under Doctor Jehle's authorship, an article on "Characteristics of Citrus Canker and of the Causal Organism" was published in the Quarterly Bulletin for January, 1917, and another entitled "Effect of Disinfectants upon *Bacterium citri*" in the Quarterly Bulletin for January, 1918.

In October, 1917, it was decided to discontinue the work at the laboratory. This conclusion was reached on several considerations. In the first place it was evident that as much information as possible, bearing upon the practical work of eradicating citrus canker, had been secured. Secondly, as the disease was apparently almost eradicated in south Dade County, it was deemed unwise to continue keeping canker-infected trees in existence, even in a screened cage. Finally, it was felt that the funds required to maintain the laboratory could henceforth be used to greater advantage in actual inspection and eradication work. The water works, gas plant and two sterilizers at the laboratory were transferred to the South Dade County Fruit Growers' and Truckers' Association, the Association desiring to keep sufficient permanent equipment so that local investigations of various diseases could be made as occasion required. The remaining laboratory equipment was shipped to Gainesville where it is now in storage at the University.

In October, 1917, Doctor Jehle accepted a position with the Bureau of Plant Industry, after having rendered faithful service to the Plant Board during the continuation of the laboratory investigations.

Since the discontinuance of the laboratory no plant pathological work has been conducted by the Plant Board. During this period, however, the Plant Commissioner and his staff have had the benefit of the advice and counsel of Prof. P. H. Rolfs, Director,

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and Prof. H. E. Stevens, Plant Pathologist of the University of Florida Experiment Station.

PUBLICATIONS

The State Plant Board issues three publications, the "Circulars", The Quarterly Bulletin and "Port and Railway Inspection Notices".

CIRCULARS

The Circulars of the Plant Board, published in relatively small editions, give publicity, as required by law, to all rules, regulations and public notices adopted or promulgated by the Board. They are issued as necessary, and the frequency of their issue is dependent entirely upon the necessity of the Board making changes in its rules as the result of experience or the occurrence of unusual conditions.

Since our last report, Circulars Nos. 18 to 30, inclusive, have been issued. Circular 30, issued July 31, 1918, contains all Rules and Public Notices of the Board as now in effect, together with the Florida Plant Act of 1915.

THE QUARTERLY BULLETIN

Publication of The Quarterly Bulletin was commenced in October, 1916, a copy of Vol. I, No. 1, having been submitted with our last report. The Quarterly Bulletin has been issued regularly during the biennium. It has been the object of the editors to include in The Quarterly Bulletin only such articles as possess a permanent value and can be used for distribution for many years to come. During the biennium articles by competent authorities have been published upon fumigating nursery stock, citrus canker, the pineapple black weevil, sweet potato weevil, Mediterranean fruit fly, Florida scale-insects, avocado weevil, citrus blast, the pink bollworm and diseases of the sweet potato, as well as regular quarterly reports on the citrus canker eradication work, port and railway inspection and parcel post inspection services.

The Quarterly Bulletin is the only official publication in Florida devoted exclusively to the prevention, control and eradication of injurious insects and plant diseases and has repeatedly

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proven its value to growers and farmers. Your Plant Commissioner recommends that facilities be provided for its continued publication and enlargement during the next two years.

Port and Railway Circulars

These circulars contain such sections of the Plant Act and Rules of the Board as are of interest and importance to common carriers, steamship companies and importers of plant products. Such explanatory matter is included as will make clear the application of various quarantine orders, etc., and the Board rules are arranged according to subject. Editions are limited to the number of copies required for distribution to common carriers and their agents and such importers as are affected by the Board's rules.

Timely articles on various subjects have been furnished the agricultural press of the State from time to time.

EMPLOYEES

Because of its co-operation with the Bureau of Plant Industry and Federal Horticultural Board, the Plant Board must of necessity have a large number of employees. It has also, with a few exceptions, had to train its employees for the work which they were to do. The maximum number of employees was reached in August and September, 1916, when the fight on citrus canker was at its most critical stage. During those months 418 employees were on the rolls. Since that time the force has gradually been reduced, there being 230 salaried employees on April 30, 1918.

Efficiency and fitness have been the sole qualifications for employment by the Board. In no case have positions been filled for personal or political reasons, and the employees now upon the force are, without exception, experienced, efficient and thoroughly devoted to the interests of the public.

In reducing its force, the Plant Board has found it advisable to retain in its service the most efficient employees, granting them advances in salary commensurate with their value and ability.

Vacations

Vacations are granted to employees of the Board only upon special Board action in each case. The amount of vacation time

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granted, from the creation of the Plant Board on May 4, 1915, to April 30, 1918, has averaged 2.16 days per employee per year of service.

PERSONNEL

In the Plant Commissioner's office complete records are kept concerning each employee, his term of service, efficiency, salary, etc. Space prevents publication of the names and terms of service of all employees, hence we give here only the names of the employees in service at the end of the fiscal year April 30, 1918:

EMPLOYEES, APRIL 30, 1918:

Mack, Bryan (Tallahassee) ..... *Secretary*
Kellum, J. G. (Tallahassee) ..... *Auditor*

PLANT COMMISSIONER'S OFFICE

Newell, Wilmon ..... *Plant Commissioner*
Goodwin, J. C. ..... *Chief Clerk*
Stone, O. T. ..... *Office Assistant*
Cornwell, Miss Madge E. ..... *Stenographer*
Carlisle, Mrs. Kathleen R. ..... *Stenographer*
Murrill, Miss Ethel R. ..... *Stenographer*
Carey, Mrs. Bertha A. ..... *Stenographer*
Means, Miss Eva C. ..... *Filing Clerk*
Lloyd, Henry (col.) ..... *Janitor*

DEPARTMENT OF CITRUS CANKER ERADICATION

Stirling, Frank ..... *General Inspector*
Montgomery, J. H. ..... *General Grove Supervisor*
Holton, John C. ..... *Assistant General Inspector*
Hecker, Mrs. Lottie A. ..... *Stenographer*

District Inspectors

Bass, Milledge M.
Campbell, M. G.
Daniel, L. A.
Gist, J. V.
Heck, Joy
Mears, John M.
Nieland, F. C.
Schlobig, John
Smith, Cleve F.
Swanson, A. L.
Wartmann, H. A.

Assistant District Inspectors

Artis, Harvey C.
Benedict, Wm. L.
Carter, H. G.
Dunaway, Wilbur E.
Gaston, B. O.
Goldberg, E. R.
Hoenshel, Paul M.
Kerr, James
Potter, E. R.
Tedder, Geo. E.

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Foremen

Adams, Arthur
Adams, B. F.
Bateman, R. G.
Browne, C. E.
Burden, G. F.
Cash, R. P.
Cellon, F. M.
Culley, P. E.
Dillingham, H. J.
Eikenberry, H. D.
Eiland, John
Flowers, B. L.
Ford, Arthur E.
Gibson, P. B.
Gossman, Harvey L.
Gwynn, E. L.
Haywood, F. E.
Henderson, R. C.
Henderson, Wm. H.
Ingram, John W.
Johnson, August P.
Kelley, Emory L.
Laing, James D.
Liles, Edd.
Lindner, Ross W.
Ludlam, Jos. W.
McClanahan, S. L.
Mahan, Wm. D.
Mendel, James C.
Millington, Wm. V.
Nutting, Chas. T.
O'Shields, Odom S.
Raab, Albert G.
Reynolds, David N.
Reynolds, Roscoe
Richmond, Leon C.
Schumacher, Henry F.
Sheffield, C. P.
Stephens, Wm. L.
Strain, John G.
Thomas, Willious H.
Wade, Geo. W.
Witt, Henry S.

Inspectors

Alexander, David N.
Alexander, Guy T.
Baillie, Wm. J.
Baker, J. Otis
Baker, L. J.
Bass, Clarence A.
Beaty, Alwyn L.
Beville, Ulmont U.
Blackburn, Grover C.
Bosse, Rufus F.
Boyett, Marshal M.
Brown, Chas. M.
Brown, Merle R.
Brown, Ollie D.
Buff, Wm. D.
Butler, Lee
Carter, D. T.
Cash, R. A.
Clinger, John A.
Conner, Daniel S.
Curry, W. R.
Daughtrey, J. A.
Douglass, Elmer E.
Dukes, James R.
Dyson, Zeblon V.
Ellis, Thos. R.
Fish, Robert E.
Fitch, Samuel H.
Freeman, Jesse W.
Frierson, Ed.
Frierson, Hill H.
Fry, Benjamin B.
Fuller, Richard M.
Green, Joseph T.
Hall, Clayton E.
Hammell, David L.
Hansen, Hans W. A.
Harden, John C.
Hawkins, H. S.
Hayman, Jas. T.
Henderson, J. Harvey
Holland, Edward Alton
Holland, James S.
Holland, Jos. W.
Hooker, A. S.
Irwin, Harry M.
Janes, George
Jenness, Walter E.
Kersey, Walter L.
Kinyoun, Gray
Lahrman, Walter O.
Lamb, Kirkland S.
Lazonby, J. Lionel
Lee, Dock
Lee, Russell E.
LeRoy, Merton
Little, Arnaud R.
Lott, W. V.
McAllister, A. O.
McLendon, Albert S.
McLendon, John A.
McLendon, Henry L.
Mahan, Chas. R.
Marsh, James F.
Marshall, Galen G.
Melendy, B. E.
Merrill, Wm. H.
Milledge, Stanley
Morgan, Jas. R.
Nixon, Roy R.
Noxtine, H. A.
Oakley, Archie R.
Oliphant, Ross G.
O'Quinn, D. Henderson
Parham, Harry C.
Park, Bradley
Parker, Frank R.
Perkin, Howard W.
Pinelli, John
Poucher, A.
Pryor, T. J.
Putnal, Bonnie W.
Robertson, Paul F.
Robinson, Vernon K.
Rodgers, Wm. B.
Ross, James B.
Royal, John W.
Rudesill, Dick
Scudder, Hamilton F.
Sealey, John
Shelton, J. L.
Shriner, Ike M.
Smith, Herman D.
Smith, Lonnie S.
Spiller, Wm. A.
Stephens, Robert C.
Stevenson, Elbert M.
Stevenson, Geo. A.
Stevenson, Richard D.
Stokes, Clifford
Strong. C. E.
Taylor, Jesse F.
Thomas, Paul
Thompson, Roy
Thomson, James
Thurmond, J. W.
Ulmer, Henry L.
Ulmer, Julius E.
Ulmer, Robert L.
Wahlberg, Emil
Walker, Shirley B.
Wallace, D. W.
Wells, Benjamin B.
Wilson, James H.
Wilson, Jos. H.

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Department of Nursery Inspection

O'Byrne, F. M.	*Nursery Inspector*
Baker, Geo. H	*Assistant Nursery Inspector*
Baker, Thos. J.	*Assistant Nursery Inspector*
Chaffin, J.	*Assistant Nursery Inspector*
Hall, James E. B.	*Assistant Nursery Inspector*
Knight, Robert A.	*Assistant Nursery Inspector*
Linger, Russell B.	*Assistant Nursery Inspector*
Mowry, Harold	*Assistant Nursery Inspector*
Nanney, W. C.	*Assistant Nursery Inspector*
Potter, Roscoe D.	*Assistant Nursery Inspector*
Swartsel, Howard B.	*Assistant Nursery Inspector*
Walker, Shirley B.	*Assistant Nursery Inspector*
Wartmann, H. A.	*Assistant Nursery Inspector*
Whittington, C. E.	*Assistant Nursery Inspector*
DaCosta, Miss Mary W.	*Stenographer*
McIlvaine, Miss Lucretia	*Stenographer*
Colson, Mrs. K. D.	*Stenographer*

Packing-house Inspectors*

Black, W. C.	Frese, J. A.	Parker, Phil C.
Blackburn, G. W.	Gates, Josiah	Price, Jack
Bruyiere, J.	Gillingham, H.	Pylant, S. Lee
Carn, B. O.	Hendrix, D. A.	Right, W. W.
Cartledge, E. V.	Humbarger, John	Robertson, A. H.
Cason, J. W.	Knowles, Austin	Robles, J. H.
Cobb, J. W.	Layton, W. I.	Rogers, O. H.
Coile, J. G.	Leisegang, Conrad	Roper, B. H.
Collins, W. B.	Liphard, F. C.	Scorgie, L. A.
Cox, S. C.	Little, F. D.	Sessions, E. R.
Dade, W. A.	Luce, D. H.	Shelton, J. S.
DeLanoy, S. S.	McKnight, T. J.	Smith, L. W.
Dowdell, Silas	McRee, J. N.	Stoltz, F. W.
Eastman, H. L.	Millen, S. E.	Thompson, J. N.
Ellas, H. S.	Mulrennan, Joe	Thullbery, C. C.
Flint, J. H.	Newbank, Neil	Townsend, L. E.
Flood, H. V.	Nighswanger, L. Z.	Williams, Boyce
Flowers, W. H.	Oesterle, Chas.	Wirt, T. E.
Ford, George	Oliver, T. S.	Young, A. I.

Department of Entomology

Berger, E. W.	*Entomologist*
Merrill, Geo. B.	*Acting Assistant Entomologist*
Evans, Miss Ella M.	*Stenographer*

Department of Port and Railway Inspection
(Plant Commissioner in Charge)

Bragdon, K. E.	*Deputy Port and Railway Inspector*
Gehry, Emil L.	*Deputy Port and Railway Inspector*
Graham, Erwin M.	*Deputy Port and Railway Inspector*
Hull, W. N.	*Deputy Port and Railway Inspector*
Thompson, Troy	*Deputy Port and Railway Inspector*
Zeluff, U. C.	*Deputy Port and Railway Inspector*

*"Packing-house inspectors" are employed to supervise the fumigating, dipping, scrubbing or other preeautionary treatments prescribed for nursery stock packed by certain nurseries, such as those occurring in cottony cushion-scale areas, and are paid only for time actually employed. The wages of the packing-house inspectors are charged to the nurseries in which their work is performed. The Plant Board incurs no expense for their services.

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SUPPLEMENTAL REPORT

May 1 to September 30, 1918

During this period the work of the Board has been continued with little interruption along the same lines as heretofore. Some decrease in the number of employees has taken place, due to entrance of men into the Army and Navy and also due to the attractive salaries available in other lines of work. Continued progress in the canker eradication work has also permitted a gradual decrease in the number of employees engaged in citrus inspection work.

Among the most striking developments during this period has been the discovery of additional infestations by the banana root-borer and an unprecedented outbreak of the semi-tropical army worm. More detailed reference is made to these below.

CITRUS CANKER ERADICATION

During this period, no infections were found in sections or localities not previously infected.

During May one infection was found in one of the hitherto infected properties and in June two new properties in previously infected centers showed infection.

During the balance of this period, July, August and September, no canker was found, although the inspection work was kept up to the maximum of efficiency.

The work done, together with the results accomplished, are shown in the following table:

Month	Grove trees inspected	Nursery trees inspected	New properties infected	Properties declared no longer "danger centers"	Number inspectors employed
May	749,650	4,856,106	0	0	210
June	702,752	4,463,078	2	6	200
July	540,713	5,018,350	0	1	193
August	559,063	4,655,810	0	0	190
September	494,060	4,071,145	0	4	186
Total	3,046,238	23,064,489	2	11	

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Grand Summary, Canker Eradication Work, to Sept. 30, 1918

Properties found infected May 1, 1914, to April 30, 1918	477	
Additional properties found infected between May 1 and Sept. 30, 1918	2	
Total properties infected to September 30, 1918		479
Properties declared no longer danger centers to April 30, 1918	426	
Declared no longer danger centers between May 1 and Sept. 30, 1918	11	
Total		437
Properties still classed as infected September 30, 1918		42

Nursery Inspection

Regular inspections of the nurseries heretofore mentioned have been continued and 81 additional nurseries were located and inspected for the first time.

Tabulated Report of Inspections

Number of nurseries inspected from May 1, 1918, to Sept. 30, 1918	1572
Total number of inspections made from May 1, to Sept. 30, 1918	2319
Number of nurseries inspected for the first time, May 1 to Sept. 30, 1918	81

Certification Refusals

From May 1 to September 30, 1918, the total number of certification refusals, for the reasons indicated, was as follows:

Avocado scab	28
San Jose scale	17
California red scale	34
Camphor thrips	4
Whitefly and scale	621
Excessive citrus scab	0
Dictyospermum scale	1
Foot-rot of citrus	2
Red-banded thrips	0
Dieback of pecan	0
Other causes	55
Total	762

Quarantines

Quarantines were imposed as follows:

Canker in nursery	0
Nursery in canker zone or a contact property	56
Other causes	3
Total	59

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Inspection Certificates Issued

From May 1 to September 30, 1918, the number of inspection certificates issued was as follows:

Kind of tag	Number of tags issued				
Regular tags	14,851	to	85	firms	and individuals
Package tags	223	"	20	"	"
Scaly-bark tags	345	"	7	"	"
Stock-dealers' tags	1,100	"	3	"	"
Florida permit-tags	7,189	"	43	"	"
Total	23,708	"	158	"	"

QUARANTINE DEPARTMENT

This Department, as originally established by the Board, was designated as the "Port and Railway Inspection Department". During the past two years, however, much work other than actual inspection at ports and railway centers has become necessary and as this work involves quarantines to a greater or less extent such work properly falls to the lot of this Department. For example, the discovery of the banana root-borer in the State and the necessity for its eradication, as well as the urgent necessity of restricting the further spread of the sweet potato weevil through quarantine and other measures, has added new duties to this Department. The Board therefore felt that the former name of the department did not adequately describe its functions and at its meeting at St. Augustine on May 10, 1918, changed the name to that of "Quarantine Department", at the same time electing Dr. J. H. Montgomery, formerly General Grove Supervisor in the canker eradication work, to the position of Quarantine Inspector and Chief of the Department. By the same action, assistant inspectors in this Department were designated as "Assistant Quarantine Inspectors".

Since the conclusion of our report of April 30, 1918, we have continued to strengthen and extend the work of the Quarantine Department. This has been made necessary largely because of certain activities on the part of the military and naval authorities, the exact nature of which it is not permissible to print in this report.

Interceptions

Although injurious insects and diseases are intercepted every day of the year by inspectors of the Quarantine Department, some of the interceptions are worthy of special attention. One

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such was the interception at Key West of a shipment of guavas from Cuba which were infested with the West Indian fruit-fly, a pest which, in Cuba, does great injury to many of the fruits which are grown on a commercial scale in Florida.

Two very recent interceptions have been made, the importance of which justifies mention, despite they were made since the end of the period (September 30th) covered by this supplemental report.

On October 10th Assistant Quarantine Inspector Paul M. Hoenshel at Jacksonville intercepted a shipment of sweet potatoes from Porto Rico which were infested with the sweet potato scarabee. The establishment of this insect in Florida would doubtless cause as much injury to the sweet potato industry as the sweet potato weevil, which is already present in parts of the State (see page 68).

On October 15th, Assistant Nursery Inspector Howard B. Swartsel, while inspecting a carload of birch hoops in Manatee County, which hoops had been shipped from Massachusetts, found several egg-masses of the Gypsy moth. The latter is one of the most destructive insect pests of fruit and forest trees in the United States, and in New England, where large sums have been spent in its control, it is referred to as the "billion dollar pest". By this discovery Inspector Swartsel very likely prevented the establishment of this insect in Florida.

Inspections Made

Following is a tabular statement of the inspection work by the Quarantine Department from May 1 to September 30, 1918:

VESSELS INSPECTED:		
From foreign ports	703	
From U. S. ports other than Florida	323	
From Florida ports	471	
Total		1497
SHIPMENTS INSPECTED:		
Arriving by water—		
Passed	11,833	
Treated and passed	100½	
Returned to shipper	143	
Detained, subject to return by shipper	0	
Contraband destroyed	786½	
Total		12,863
Arriving by land—Express, freight, wagons, etc.		
Passed	1,336	
Treated and passed	127	
Returned to shipper	71	
Detained, subject to return by shipper	36	
Contraband destroyed	41	
Total		1611
Total shipments inspected		14,474

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Parcel Post Plant Inspection

The inspection of plant products being sent by mail to Florida postoffices has been continued in the manner outlined in our main report (see page 61).

Owing to the lack of co-operation in turning over to the Plant Board agents material subject to inspection and on account of many postmasters not fully understanding the importance of this inspection work it was decided in August, 1918, to have Special Inspector Kirkland S. Lamb call in person upon postmasters and secure their co-operation. Between August 17th and September 30th, Mr. Lamb called upon and interviewed 120 postmasters, securing their promise of co-operation. During the same period Mr. Lamb called upon 149 freight and express agents in the towns visited, for the purpose of seeing that they understood the various rules and regulations of the Board concerning shipment of nursery stock, sweet potato plants, etc. The results thus far obtained show that the plan of having an inspector personally confer with postmasters and transportation agents is productive of much good and is a practice for which provision should be made during the next two years as indicated in our main report (page 62).

Parcels Inspected

Following is a tabular statement of the parcel post packages of plants and plant products inspected by the Board's agents between May 1 and September 30:

PARCELS INSPECTED:		
Passed	831	
Treated and passed	43	
Returned to sender	0	
Detained, subject to return by sender	7	
Infested or infected parcels destroyed	6	
Total parcels inspected		887

Sweet Potato Weevil

Additional infested points have been found in counties already known to contain one or more infested localities. Inspectors of the Plant Board and of the Bureau of Entomology, U. S. Dept. of Agriculture, found infestations at Punta Rassa, Fort Myers and Useppa Island in Lee County, at Deerfield in Broward County, Delray in Palm Beach County, Rio, Oslo and Vero in St. Lucie County, Tarpon Springs in Pinellas County and Ormond Beach in Volusia County.

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The insect has also been found infesting two species of morning glories not heretofore found infested in Florida, namely, *Ipomoea pandurata* and *Ipomoea littoralis*. The first-named morning glory prefers high sandy land while the second grows along the seacoast.

The Plant Board's efforts to prevent spread of the weevil from the areas already infested, by means of suitable quarantines, are being continued.

Banana Root Borer

Further investigation showed that the area in Manatee County infested with this insect comprised 14 properties, in addition to the one first found infested. There were on these properties 14,675 banana plants, not including one banana field of 1½ acres of closely matted plants. Further spread of the pest could be prevented only by the destruction of the infested plantings. The necessary permission for this step was in all cases secured from the owners, and Assistant Nursery Inspector Howard B. Swartsel was detailed to supervise the task. On May 8, 1918, the assistance of the Federal Horticultural Board, U. S. Department of Agriculture, was secured, the Board through its Chairman, Mr. C. L. Marlatt, kindly offering to pay a part of the cost of disposing of the infested plantings. During May and June all the infested plantings were destroyed. During this period the Federal Horticultural Board defrayed labor expenses to the amount of $284.25. As soon as the infested plantings were destroyed, "traps" for any remaining weevils were put into use, as explained on p. 72 of the foregoing report. This trapping is still being continued in the hope of getting absolutely all of the banana root-borer weevils. This work is now being done by Mr. A. F. Collins, a local grower.

Available funds have not yet permitted of a systematic inspection of all shipments of banana plants made from the south Florida nursery which was found infested with the banana root-borer in March, 1918. In co-operation with the Federal Horticultural Board, however, the owners of all these plantings have been written to and in all cases where the owner reported his banana plants as being unhealthy or having died an inspector was detailed to make an inspection of them. Such inspections as have been made have brought to light one infested property located in Polk County. This infestation was found on September 16, 1918,

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by Assistant Nursery Inspector W. C. Nanney. With the owner's consent all banana plants in this planting were destroyed at once. Inspection of all nearby banana plantings did not reveal infestation and led to the conclusion that the insect had not spread from this one planting, which was made with banana plants from the infested nursery referred to.

Black Fly

Mention was made in our main report (page 75) of Messrs. L. Russell Warner and H. D. Bollinger having been employed by the Office of Plant Sanitation in Havana to assist in control of the black fly. Mr. Bollinger returned to Florida on June 1st and Mr. Warner on August 1st. With their co-operation and assistance the Office of Plant Sanitation made good progress, during the late winter and spring months, in its fight on the pest in Havana, greatly reducing the degree of infestation and reducing correspondingly the chances of the insect being brought to Florida on vessels from Havana.

Our efforts to prevent the introduction into this State of the black fly have not been relaxed in any degree. On the contrary the quarantine measures have been made more stringent. Reports from our inspectors located at Key West and Tampa showed that fruit shipments from Cuba frequently contained leaves and other material likely to transmit the black fly. Efforts to have the shippers abate this practice proving ineffective, the Plant Board, at its meeting on July 12, 1918, instructed the Plant Commissioner to order the deportation of all packages of fruit arriving from Cuba containing leaves, twigs, etc. This order became operative August 1st. Prior to this date the Cuban Government was notified of the action of the Board and wide publicity obtained.

The records of this department show that during the period from May 1 to September 30, 1918, there arrived at Key West and Port Tampa from Cuba 42,834 packages of fruit. Of this number 16,834 packages came in after the time when the Board's order went into effect. The task of inspecting these packages was one of magnitude but was accomplished. Due to publicity given the order in Cuba shippers were more careful in preparing shipments. Even so our inspectors detected the presence of prohibited material in 81 packages of fruit. These were deported.

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Pink Bollworm Quarantine

Reports from the authorities in charge of the Pink Bollworm eradication work in Texas have continued to show lack of full co-operation of cotton growers in the infested area, as well as failure on the part of the courts to enforce the Texas bollworm law. These reports were of such a nature as to make inadvisable any modification of the Plant Board's quarantine. On the contrary the need of greater precaution was evident and on May 10, 1918, the Board amended its Rule 37, dividing it into Rules 37A and 37B and adding an additional safeguard by prohibiting the shipment into Florida of cotton linters, cotton waste, samplings, sweepings and damaged cotton from points east of the Mississippi River except on permits of the Plant Commissioner, issued after the receipt of satisfactory assurances as to the safety of the shipments in question.

In applying these regulations the agents of the Board at Jacksonville have on several occasions intercepted cotton shipments coming from the vicinity of the infested Texas area. Such shipments have been deported from Florida without delay.

Department of Entomology

The work of this Department has continued without interruption. During this period 901 cultures of the red whitefly fungus have been distributed, as have also 193 cultures of the yellow Aschersonia for the control of the woolly whitefly. In connection with control of the cottony cushion-scale, 60 colonies of the Australian lady-bird beetle have been distributed to growers. Eight hundred and fifty-six specimens of insects, mostly injurious, have also been received and identified.

The Entomologist rendered special and valuable service in connection with the severe outbreaks of the semi-tropical army worm during July. This outbreak is discussed more in detail below.

Department of Plant Pathology

In view of the need of technical advice and information regarding various plant diseases on the part of its staff, the Plant Board, at its meeting on May 10, 1918, elected Prof. H. E. Stevens, Plant Pathologist of the University of Florida Experiment Station, to the position of "Consulting Plant Pathologist" of the Plant Board. Prof. Stevens' appointment to this position became effective July 1, 1918, at a salary of $400.00 per annum.

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Prof. Stevens is called upon from time to time to identify specimens of plant diseases taken in connection with the inspection and quarantine work, answers inquiries from farmers and growers concerning plant diseases, etc.

Semi-tropical Army Worm

The past spring a large acreage of castor beans was planted in Florida, under Government contracts, for the purpose of supplying beans from which castor oil could be made for aeroplane motors.

The semi-tropical army worm is an insect which is found every year in Florida, usually in such small numbers that it does not attract attention. A few of these worms were reported about the middle of June, by District Inspector A. L. Swanson, as feeding on castor bean plants in Palm Beach County.

About the middle of July the pest appeared in very considerable numbers and by July 23rd the outbreak had assumed a serious phase, particularly in St. Lucie, Palm Beach, Dade, Hillsborough, Polk and DeSoto Counties.

On July 23rd the Plant Commissioner wired instructions to the District Inspectors in the East Coast counties from Brevard to Dade to place practically all citrus canker inspectors at work assisting castor bean and cotton growers in combating the worms. At about the same time telegrams were received from the Miami Chamber of Commerce, contractors and others, asking the Plant Board's assistance in the emergency.

On July 24th it became evident that the army worms were so abundant in parts of Hillsborough, Polk and DeSoto Counties that several thousand acres of castor beans there were threatened with destruction. Accordingly inspectors in the employ of the Plant Board in central and western Florida were also placed on the army worm work.

The inspectors made personal visits to all castor bean growers in the affected territory, inspected the castor bean fields and in each instance called attentioin of the owner to the presence of the pest in his field and advised him how to control it. In many instances where the worms had, at the time of the inspector's visit, reached sufficient size to do considerable damage, the inspectors themselves sprayed the castor bean fields with powdered arsenate of lead, using dust sprayers for the purpose, a supply of both being carried by the inspectors at all times.

The fight against the army worm was waged intensively until

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about August 12th, by which time the pest had been brought under control and appreciable damage averted except in the case of a few fields where the worms had practically destroyed all foliage on the bean plants before the fields could be reached by the inspectors.

In this work the Plant Board agents were assisted by agents of the Bureau of Entomology and Bureau of Plant Industry, U. S. Department of Agriculture, by the Government's castor bean contractors and, in some instances, by the county demonstration agents. As soon as the seriousness of the situation became apparent the Bureau of Aircraft Production at Washington was appealed to for supplies of powdered lead arsenate with which to treat the infested fields. The Bureau purchased 5500 pounds of the poison and had it shipped to Florida for distribution under the Plant Commissioner's direction to castor bean growers who needed it. For various reasons this material did not arrive until the fight against the worms was practically won and but a few hundred pounds were therefore actually used.

In dealing with the emergency created by this outbreak of the army worm the Plant Board was called upon to make rather heavy expenditures. A total of $1,946.85* was expended by the Board, covering traveling expenses of inspectors, telegrams, emergency circulars, dusting machines, poison, etc. The large quantity of castor beans saved from destruction, and therefore made available for the use of the Government, more than justified the expenditure.

Writing under date of August 15, 1918, one of the Government's castor bean contractors said:

"I cannot say with any degree of accuracy how many thousands of dollars the State Plant Board has saved in the army worm fight. I would say that you have certainly saved whatever our castor bean crop results in at the end of the season."

Another contractor, under date of August 18th, wrote the Plant Commissioner in part as follows:

"We wish to make acknowledgment to the State Plant Board of our appreciation of the splendid work done and the great public service performed during the past month by the inspectors of the Board in combating the army worms. So far as the castor bean crop is concerned, its money value is probably of smaller consequence than its military importance, and for this reason the prompt and effective work of your inspectors in aiding to save the crop has been of a value to the Nation of such importance as can now only vaguely be guessed. It may be that in helping to save the castor beans your men have done much to help win the war. That the army of

*Distributed as follows: Out of Plant Act General Fund; salaries $84.44. Out of Special Fund; salaries, $262.22 and expenses, $1,600.19. Salaries of other inspectors on army worm work were defrayed by the U. S. Dept. of Agriculture.

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"minute men" of the Plant Board was thrown into action within a few hours after the first appeal to you for aid, speaks volumes for the efficiency of your organization and the fine sense of public duty and responsibility held by the Plant Board."

The Chairman of the Plant Board and the Plant Commissioner, respectively, were also in receipt of letters from the Office of the Director of Aircraft Production, thanking the Board for its activities in preventing damage to the Florida castor bean crop.

Following the middle of August, damage by the semi-tropical army worm was on the wane, due largely to the increase of parasites with each succeeding generation of the worms.

FINANCIAL REPORT

Tallahassee, Florida, October 1, 1918.

To the State Plant Board of Florida:

Gentlemen: I have the honor to submit the following report of the finances of the Board for the period beginning May 1, 1916, and ending April 30, 1918. I am also submitting an additional report for the period beginning May 1, 1918, and ending September 30, 1918, but this does not include expenditures for September, approved at the October meeting of the Board:

SUMMARY

Resources

General appropriation for fiscal year ending April 30, 1917	$ 85,000.00	
General appropriation for fiscal year ending April 30, 1918	35,000.00	
Balance Donations and Incidental Collections Fund after paying bills for April, 1916	2,632.64	
Donations and Incidental Collections from April 30, 1916, to April 30, 1918	11,066.44	
Balance in Special Appropriation after paying expenses for April, 1916	16,007.95	
Special Appropriations for Citrus Canker Eradication, etc.	150,000.00	
Total Resources		$249,707.03

Expenditures

For Salaries	$156,758.74	
For Office Supplies	6,759.89	
For Traveling Expenses	35,335.04	
For Printing Bulletins	6,352.97	
For General Supplies	9,780.80	
For Miscellaneous Expenses	3,901.31	
Unexpended part of General Appropriation	57.50	
Total Expenditures		$218,946.25
Balance after expenditures for April, 1918, are deducted		$ 30,760.78

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ITEMIZED EXPENDITURES
GENERAL FUND

Resources

General Appropriation for fiscal year ending April 30, 1917	$ 35,000.00	
General Appropriation for fiscal year ending April 30, 1918	35,000.00	
Total Resources		$ 70,000.00

Expenditures

For Salaries	$ 52,505.86	
For Office Supplies	4,540.68	
For Traveling Expenses	7,123.69	
For Printing Bulletins	2,429.91	
For General Supplies	2,756.21	
For Miscellaneous Expenses	586.15	
Refund of unexpended balance, 1917	56.87	
Refund of unexpended balance, 1918	.63	
Total Expenditures		$70,000.00*

*The disbursement of the General Fund for the fiscal year ending April 30, 1917, classified by departments rather than by items, was as follows:

Plant Board, Expenses	$ 87.81	
Advisory Committee, Expenses	56.60	
Secretary's Office (Tallahassee)	1218.93	
Plant Commissioner's Office (Gainesville)	12165.18	
Department of Entomology	4560.67	
Department of Nursery Inspection	7170.78	
Department of Plant Pathology	521.48	
Department of Port & Railway Inspection	9166.78	
Unexpended balance reverting	56.87	
Total		$ 35,000.00

Disbursement of the General Fund for the fiscal year ending April 30, 1918, by departments, was as follows:

Plant Board, Expenses	$ 1040.02	
Secretary's Office	1502.62	
Plant Commissioner's Office	11514.56	
Department of Entomology	5380.61	
Department of Nursery Inspection	8640.25	
Department of Port & Railway Inspection	6921.31	
Unexpended balance reverting	.63	
Total		$ 35,000.00

—Plant Commissioner.

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SPECIAL FUND

Resources

Amount unexpended after paying expenses for April, 1916	$ 16,007.95	
Appropriation by Legislature for Citrus Canker Eradication, etc., available July 1, 1917	150,000.00	
Total Resources		$166,007.95

Expenditures

For Salaries	$ 96,918.57	
For Office Supplies	2,159.05	
For Traveling Expenses	27,974.46	
For Printing Bulletins	3,911.11	
For General Supplies	3,531.29	
For Miscellaneous Expenses	3,144.37	
Total Expenditures		$137,638.85†
Unexpended balance after paying April, 1918, expenses		$ 28,369.10

DONATIONS AND INCIDENTAL COLLECTIONS

Resources

Unexpended balance after paying expenses for April, 1916	$ 2,632.64	
Donations and Incidental Collections from April 30, 1916, to April 30, 1918	11,066.44	
Total Resources		$ 13,699.08

Expenditures

For Salaries	$ 7,334.31	
For Office Supplies	60.16	
For Traveling Expenses	236.89	
For Printing Bulletins	11.95	
For General Supplies	3,493.30	
For Miscellaneous Expenses	170.79	
Total Expenditures		$ 11,307.40
Balance unexpended after paying April, 1918, expenses		$ 2,391.68

†This sum, during the two fiscal years ending April 30, 1918, was expended for the following purposes:

Citrus Canker Eradication	$119,718.57
Nursery Inspection	10,436.64
Plant Disease Investigations and Control	836.61
Quarantine Work and Inspection	6,633.15
Preventing Spread of Sweet Potato Weevil	13.88
Total	$137,638.85

—Plant Commissioner.

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SUPPLEMENTARY REPORT, FROM APRIL 30, 1918, TO SEPTEMBER 30, 1918

GENERAL FUND

Resources

General Appropriation for fiscal year ending April 30, 1919	$ 35,000.00	
		$ 35,000.00

Expenditures

For Salaries	$ 4,141.78	
For Office Expenses	495.81	
For Traveling Expenses	431.00	
For Printing Bulletins	151.30	
For General Supplies	908.35	
For Miscellaneous Expenses	28.14	
Total Expenditures		$ 6,156.38*
Balance unexpended September 30, 1918		$ 28,843.62

SPECIAL FUND

Resources

Unexpended Balance after paying expenses for April, 1918	$ 28,369.10	
Special Appropriation for Citrus Canker Eradication, etc., available July 1, 1918	150,000.00	
Total Resources		$178,369.10

Expenditures

For Salaries	$ 26,114.69	
For Office Supplies	3,683.21	
For Traveling Expenses	14,483.53	
For Printing Bulletins	907.17	
For General Supplies	1,486.35	
For Miscellaneous Expenses	211.96	
Total Expenditures		$ 46,886.91†
Balance unexpended September 30, 1918		$131,482.19

*Does not include expenses incurred during September, 1918, vouchers for which were approved at the October meeting of the Board.

†Bills for the month of September (which were approved by the Board at its October meeting) not included.

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DONATIONS AND INCIDENTAL COLLECTIONS

Resources

Unexpended Balance after paying expenses for April, 1918	$ 2,391.68	
Receipts from April 30, 1918, to September 30, 1918	2,308.89*	
Total Resources		$ 4,700.57

Expenditures

For Salaries	$ 642.53	
For Office Expenses	1.02	
For Traveling Expenses	8.54	
For Printing Bulletins	21.60	
For General Supplies	195.00	
For Miscellaneous Expenses	4.38	
Total Expenditures		$ 873.07†
Balance unexpended September 30, 1918		$ 3,827.50

Total Balance Unexpended (September, 1918, bills outstanding and awaiting approval at October meeting of Board), all funds, September 30, 1918:

General Fund	$ 28,843.62	
Special Fund	131,482.19	
Incidental Fund	3,827.50	
		$164,153.31

Respectfully submitted,

BRYAN MACK,
Secretary.

*Does not include collections for the month of September. There were reported to the Board at its October meeting.

†Does not include bills for the month of September. These were approved by the Board at its October meeting.

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ESTIMATES

The following estimates on the amounts of money required for protecting the agricultural industries of Florida, through the work of the State Plant Board in carrying out the provisions of the Florida Plant Act of 1915, are based upon a careful study of the enormous inroads made upon Florida crops and fruits by injurious insects and plant diseases, as well as upon the urgent necessity of protecting the State against invasion by several very destructive pests in the countries and islands with which commercial intercourse is either frequent or constant.

Full regard has been had to economy in the past work of the Board, as well as in preparing estimates for future needs: it being realized, however, that judicious expenditure of funds for preventing crop losses brings a return to our citizens many fold greater than the investment.

Owing to conditions prevailing during the past two years the Board has been compelled to pay its employees higher salaries than formerly. Prices of all supplies have greatly advanced and all expenses in connection with the Board's work have shown unavoidable increases. With full regard for these considerations it is believed that the estimates here given are no more than is necessary to afford adequate protection to the State's principal agricultural industries.

The various activities to which these estimates refer and the necessity therefor are quite fully explained in the foregoing pages of this report.

GENERAL FUND

Estimated Expenses per Annum*

Plant Board

Traveling Expenses, Board Members	$ 1,200.00	
Postage	350.00	
Telegrams and telephone messages	100.00	
Stenographer, Chairman's Office	1,200.00	
Stationery and Filing Cases	120.00	
Total		$ 2,970.00

Secretary's Office

Salary, Secretary	$ 1,200.00	
Traveling Expenses, Secretary	300.00	
Postage, Stationery and Telegrams	500.00	
Total		$ 2,000.00

*See page 32.

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Plant Commissioner's Office

Salaries:		
Plant Commissioner	$ 4,500.00	
1 Chief Clerk	1,800.00	
1 Filing Clerk	900.00	
4 Stenographers at $85.00 per month	4,080.00	
1 Janitor at $40.00 per month	480.00	
Total Salaries		$ 11,760.00
Traveling Expenses, Plant Commissioner	$ 400.00	
Postage and Stamped Envelopes	1,000.00	
Telephone and Telegrams	140.00	
Letterheads, Plain White Paper, Envelopes, etc.	240.00	
Office Desks, Tables and Chairs	40.00	
Filing Furniture	100.00	
Filing Folders, Guide and Record Cards, Blank Books, etc.	150.00	
Typewriter Maintenance	350.00	
Express, Drayage and Freight	160.00	
Multigraph Supplies and Maintenance	160.00	
Publication of Quarterly Bulletin,* 4 issues, 10,000 copies per issue, @ $700	2,800.00	
Postage on Quarterly Bulletin at second-class rate, 4 issues @ $18.00 per issue	72.00	
Publication of Plant Board "Circulars" containing Rules, Regulations and Public Notices of the Board as Adopted, 12 issues, 5000 copies each, at $30.00 per issue	$ 360.00	
Electricity†, 12 months at $8.00 per month	96.00	
Heat†, 4 months at $18.00 per month	72.00	
Reference Books and Technical Publications	240.00	
		$ 6,380.00
Total, Plant Commissioner's Office		$ 18,140.00

Department of Nursery Inspection

Salaries:		
Nursery Inspector (Chief of the Department)	$ 2,500.00	
14 Assistant Nursery Inspectors at $1800.00 per annum	25,200.00	
4 Stenographers at $85.00 per month	4,080.00	
1 Invoice and Certificate Clerk	1,500.00	
Total, Salaries		$ 33,280.00
Traveling Expenses:		
Nursery Inspector	$ 500.00	
14 Assistant Nursery Inspectors at $100.00 per month average	16,800.00	
		$ 17,300.00
Postage	$ 900.00	
Stationery	190.00	
Telegrams	80.00	
Typewriter Maintenance, Filing Material and Record Blanks	350.00	
		$ 1,520.00
Total, Department of Nursery Inspection		$ 52,100.00

*In lieu of all other expenses for publishing bulletins, except rules of the Board as adopted, and official notices to transportation companies.

†Payable to the University of Florida.

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Quarantine Department

Salaries:		
Quarantine Inspector (Chief of Department)	$ 2,500.00	
6 Asst. Quarantine Inspectors at $1800.00 per annum	10,800.00	
4 Asst. Quarantine Inspectors at $1600.00 per annum	6,400.00	
1 Stenographer	1,200.00	
Total, Salaries		$ 20,900.00
Traveling Expenses:		
Quarantine Inspector	650.00	
3 Asst. Quarantine Inspectors at $600.00 per annum	1,800.00	
		$ 2,450.00
Postage	$ 600.00	
Telegrams and Telephone Messages	140.00	
Stationery, Record Cards, Filing Equipment, etc.	350.00	
Port Expenses (Boat Hire, Street Car Fare, Quarantine Tags, Labor in Handling Shipments, etc.)	690.00	
Typewriter Maintenance	100.00	
Publication of Quarantine Inspection Notices, estimated 5 issues of 5000 copies each, at $25.00 per issue	125.00	
Express, Drayage and Freight	30.00	
		$ 2,035.00
Total, Quarantine Department		$ 25,385.00

Parcels-Post Plant Inspection*

Salaries:		
2 Deputy Inspectors at $1800.00 per annum	$ 3,600.00	
Traveling Expenses:		
1 Deputy Inspector at $100.00 per month	1,200.00	
Disinfectants, Fumigating Material, Tags, etc.	120.00	
Drayage on Parcel Post Packages for Inspection, between postoffice and University at Gainesville, at $5.00 per month	60.00	
Total, Parcel Post Plant Inspection		$ 4,980.00

Eradication of Sweet Potato Weevil

For preventing the spread of sweet potato weevil, control of same in infested localities, and beginning of eradication work.... $ 24,000.00

*Under an order issued by the Third Assistant Postmaster-General on October 24, 1916, all mail shipments of plants and plant products addressed for delivery at Florida postoffices are required sent to Gainesville for inspection by the State Plant Board. Subsequent to October 24, 1916, terminal inspection service was established at Jacksonville, Tampa and Pensacola, in addition to Gainesville.

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Department of Entomology

Salaries:		
Entomologist (Chief of Department)	$ 2,600.00	
1 Assistant Entomologist	2,000.00	
1 Assistant Entomologist	1,600.00	
1 Stenographer at $85.00 per month	1,020.00	
Labor	250.00	
		$ 7,470.00
Traveling Expenses:		
Entomologist	$ 300.00	
2 Assistant Entomologists	800.00	
		$ 1,100.00
Postage	$ 200.00	
Laboratory Supplies	550.00	
Express, Freight and Drayage	50.00	
Reference Books and Publications	225.00	
Furniture and Laboratory Equipment	310.00	
Photographic Supplies	75.00	
Insect Cases, Labels and Record Files	100.00	
Chemicals and Laboratory Reagents	85.00	
		$ 1,595.00
Total, Department of Entomology		$ 10,165.00

Department of Plant Pathology

Salaries:		
Consulting Plant Pathologist	$ 400.00	
Stationery and Laboratory Supplies	100.00	
Photographic Equipment	50.00	
Postage	25.00	
Total, Department of Plant Pathology		$ 575.00

Summary

Plant Board Expenses	$ 2,970.00	
Secretary's Office	2,000.00	
Plant Commissioner's Office	18,140.00	
Department of Nursery Inspection	52,100.00	
Quarantine Department	25,385.00	
Parcels-Post Plant Inspection	4,980.00	
Eradication of Sweet Potato Weevil	24,000.00	
Department of Entomology	10,165.00	
Department of Plant Pathology	575.00	
Grand Total, General Fund, per Annum		$140,315.00

Citrus Canker Eradication*

For continuing the eradication of citrus canker and inspection of citrus groves for the disease:	
For the fiscal year ending June 30, 1920	$125,000.00
For the fiscal year ending June 30, 1921	100,000.00
Total	$225,000.00

Respectfully submitted,

WILMON NEWELL,
Plant Commissioner.

Gainesville, Fla.,
November 30, 1918.

*See page 32.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

ASSOCIATE EDITORS.

E. W. BERGER.....*Entomologist*
F. M. O'BYRNE.....*Nursery Inspector*
FRANK STIRLING.....*General Inspector*
J. H. MONTGOMERY.....*Quarantine Inspector*
H. E. STEVENS.....*Consulting Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING DECEMBER 31, 1918.*

Citrus grove trees inspected	2,068,199
Citrus nursery trees inspected	12,873,595
Inspectors employed	179
New properties showing infection	0
Total properties showing active infection	0
Grove trees found infected	0
Nursery trees found infected	0
Counties in which active infections were found	0

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,723
Nursery trees found infected since May, 1914	342,254
Number properties infected to December 31, 1918	480
Properties declared no longer "danger centers"	475
Properties still classed as "infected" December 31, 1918	5

*Compiled by Mr. Frank Stirling, General Inspector.

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The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to December 31, 1918:

1914		1915		1916		1917		1918	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1
		Mar.	444	Mar.	49	Mar.	9	Mar.	1
		Apr.	408	Apr.	49	Apr.	169	Apr.	2
May	108	May	1042	May	338	May	52	May	1
June	160	June	772	June	450	June	45	June	10
July	275	July	651	July	349	July	39	July	0
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0

QUARANTINE DEPARTMENT

Report on Inspections and Interceptions, All Ports and Stations, for the Quarter Ending December 31, 1918.*

Ships and Vessels Inspected:

From foreign ports	423	
From U. S. ports other than Florida	179	
From Florida ports	213	
Total		815

Parcels Inspected:

Arriving by water:

Passed	6212½	
Treated and passed	7	
Returned to shipper	115	
Detained, subject to return by shipper	0	
Contraband destroyed	222½	
		6557

Arriving by land—express, freight, wagons, etc.:

Passed	8557½	
Treated and passed	80	
Returned to shipper	74	
Detained, subject to return by shipper	61	
Contraband destroyed	83½	
		8856
Total parcels inspected		15413

*Compiled by J. H. Montgomery, Quarantine Inspector, and K. E. Bragdon, Asst. Quarantine Inspector.

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Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of Parcels infested
Aphis, sp.	Palm	Unknown point	1
Aspidiotus sp.	Cassava	Cuba	1
Aspidiotus cocotiphagus	Cocoanut palm	Cuba	1
Aspidiotus cocotiphagus	Cocoanut palm	Florida	1
Bamboo scale	Bamboo	Florida	1
Boll worm	Corn	Cuba	1
Cactus scale	Cactus	Florida	1
Calandra oryzae	Sweet potato	Florida	1
Cigarette beetle	Cassava	Cuba	1
Citrus scab	Citrus	Alabama	1
Cottony cochineal	Cactus	Florida	1
Cottony cochineal	Fig	Florida	1
Crown gall	Hibiscus	Florida	1
Dictyospermum scale	Rose	Virginia	1
Florida red scale	Rubber plant	Florida	1
Grape root worm	Grape	North Carolina	1
Gypsy moth	Birch	Massachusetts	2
Lesser snow scale	Hibiscus	Unknown point	1
Long scale	Citrus	Florida	1
Mealy-bug	Unknown ornamental	Georgia	1
Nematode root-knot	Fig	Georgia	1
Nematode root-knot	Fig	South Carolina	1
Nematode root-knot	Peach	Florida	3
Nematode root-knot	Plum	Georgia	1
Noctuid moth	Rose	Maine	1
Oleander scale	Palm	Unknown point	1
Oyster-shell scale	Ash	Maine	1
Oyster-shell scale	Birch	Maine	1
Peach-tree borer	Peach	Florida	1
Peach-tree borer	Peach	Georgia	1
Pineapple scale	Palm	Florida	2
Purple scale	Citrus	Florida	3
Putnam's scale	Plum	Unknown point	1
Rose scale	Rose	Maine	1
Rufous scale	Rose	Florida	1
San Jose scale	Cherry	Virginia	1
San Jose scale	Peach	Georgia	2
San Jose scale	Peach	Florida	2
San Jose scale	Peach	South Carolina	1
San Jose scale	Peach	Virginia	1
San Jose scale	Plum	Florida	1
San Jose scale	Plum	Georgia	1
San Jose scale	Rose	Florida	1
Scurfy scale	Cherry	Virginia	1
Sweet potato scarabee	Sweet potato	Porto Rico	1
Sweet potato weevil	Sweet potato	Cuba	2
Sweet potato weevil	Sweet potato	Texas	1
Tent caterpillar	Birch	Maine	1
West Indian peach scale	Persimmon	Florida	1
Whitefly	Citrus	Alabama	1
Whitefly	Citrus	Florida	3
Woolly apple aphis	Apple	North Carolina	1

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Parcel Post Plant Inspection

Parcels Inspected:

Passed	293	
Treated and passed	4	
Returned to sender	1	
Detained, subject to return by sender	0	
Contraband destroyed	1	
Total parcels inspected		299

Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of Parcels infested
Aphis sp.	Rose	Unknown point	1
Chaff scale	Citrus	Florida	1
Latania scale	Fig	Florida	1
Lecanium corni	Cherry	Unknown point	1
Oleander scale	Palm	Illinois	1
San Jose scale	Rose	Unknown point	1
Whitefly	Citrus	Florida	1
White peach scale	Unknown plant	Florida	1

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Vol. III APRIL, 1919 No. 3

THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by
STATE PLANT BOARD OF FLORIDA
GAINESVILLE, FLA.

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of Florida

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. III APRIL, 1919 No. 3

IMPORTANT ANNOUNCEMENT

The circulation of the Quarterly Bulletin has now reached such a point that the expense of publication is a very considerable item. It therefore becomes necessary, for reasons of economy, to give our mailing list a severe revision, eliminating from the list the names of all those who are no longer interested in the Bulletin or do not have particular need for it.

The Quarterly Bulletin is the only publication in Florida devoted exclusively to the practical control of injurious insects and plant diseases and to their prevention and eradication. That it has accomplished something along this line is attested by the many kind comments from Florida citizens and unusually frequent and complimentary mention by officials and publications in other states and countries.

The Bulletin is sent free to all Florida citizens who request it, and it will be our policy to continue sending the Bulletin to such citizens as have real need for it, provided that the funds placed at the disposal of the Board for the coming two years admit of its continued publication.

With this number will be enclosed a return postal card. If you wish to continue receiving the Quarterly Bulletin fill out and return this card before July 1, 1919. Otherwise your name will be dropped from the mailing list.

STATISTICS ON THE CITRUS PLANTINGS IN FLORIDA

WILMON NEWELL AND FRANK STIRLING

In connection with the work of eradicating citrus canker in Florida, employees of the Plant Board and Bureau of Plant Industry have made careful records of the number of citrus trees contained in each and every planting inspected. In the attempt to locate all centers of canker infection rapid inspections, known as "scout inspections" have been made of all sections of the State, the first scout inspection of the State having been completed on February 28, 1919, after nearly four years of work.

It is believed that the records made in connection with these inspections constitute the most complete and accurate statistics

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ever secured in connection with any horticultural industry in any state, for it has been the effort of the inspectors to not only see every citrus tree in Florida but, at the same time, to make a record of it. The number of citrus trees in each county and in the State as a whole, has been compiled by Mr. Stirling from the inspection reports on the 47,401 properties inspected since May 1, 1915, and is given herewith.

A number of interesting facts are brought out by these figures. For one thing, the acreage devoted to citrus production in Florida constitutes approximately 10 per cent. of the total acreage in cultivation and the acreage devoted to citrus growing makes up 96 per cent. of the acreage given over to fruit production in the State.

The total acreage devoted to citrus trees in grove formation is found to be 160,397, of which 115,324 acres are of bearing age and 45,073 are non-bearing. The line of distinction between bearing and non-bearing trees has been arbitrarily placed at three years. That is, inspectors have reported as "bearing" all groves which, at time of inspection, had been planted out for three years or more and have reported as "non-bearing" all plantings of less than three years of age. While it is readily conceded that a grove planted out but three years can hardly be considered as actually in bearing, it is to be remembered that plantings which were three years of age when reported by the inspectors in 1915, are now 7 years of age, those reported in 1916 are now 6 years of age, etc., so that the proportion of bearing and non-bearing trees arrived at by this method is perhaps as near to the actual proportion as can be arrived at by any available method.

The following table shows the acreage in citrus in each county and also the number of citrus growers owning the trees. Many of the citrus growers have small plantings, no distinction being made in the statistics between those producing fruit on a commercial scale and those who are not. At the same time, it is conservatively estimated that fully 80 per cent. of the growers produce citrus fruits in marketable quantities.

The table on next page takes no account of citrus nursery stock. Figures on the nursery acreage are, however, readily available from the records kept in the office of Mr. F. M. O'Byrne, Nursery Inspector for the Plant Board. According to these records the total number of marketable citrus trees in Florida nurseries, on April 30, 1918, was 13,016,752.

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Citrus Plantings in Florida

Statistics Compiled by State Plant Board in Actual Inspections for Citrus Canker to February 28, 1919

County	Acres, Bearing	Acres, Non-Bearing	Trees, Bearing	Trees, Non-Bearing	Citrus Growing Properties
Alachua	696	45	48736	3160	634
Baker	26	25	1843	1738	89
Bay	33	24	2303	2361	396
Bradford	38	5	2681	334	196
Brevard	4996	2784	349746	194901	2664
Broward	387	489	27123	34229	334
Calhoun	53	15	3724	1096	31
Citrus	397	35	27776	2483	174
Clay	89	8	6217	580	165
Columbia	11	3	789	229	140
Dade	7720	2752	540432	192616	2050
Duval	355	105	24861	7339	1259
DeSoto	9272	2806	649063	196461	2387
Escambia	116	97	8131	6810	429
Flagler	107	35	7479	2442	95
Franklin	24	7	1687	488	23
Gadsden	1	2	74	120	50
Hamilton	2	2	103	115	35
Hernando	805	104	56346	7329	618
Hillsboro	6955	4367	486841	305701	4298
Holmes	4	2	292	137	25
Jackson	3	1	244	69	74
Jefferson	19	54	1379	3829	372
LaFayette	9	7	622	507	115
Lake	9788	1706	685213	119452	2534
Lee	6146	2206	430216	154435	1764
Leon	16	63	1134	4440	350
Levy	29	1	2098	55	65
Liberty	0	24	5	1716	9
Madison	8	13	574	947	226
Manatee	4872	2388	343593	169799	989
Marion	4519	402	316369	28188	643
Monroe	1409	152	211433	22718	547
Nassau	2	1	138	60	33
Okaloosa	12	6	854	425	47
Okeechobee	68	8	4745	535	28
Orange	9882	3873	691745	271139	3344
Osceola	2043	1518	122580	91080	1436
Palm Beach	1313	734	91881	51357	2108
Pasco	1511	693	105843	48535	987
Pinellas	8659	2973	606144	208144	4682
Polk	13795	8830	965635	618165	3844
Putnam	3713	464	259958	32501	1068
St. Johns	390	50	27359	3503	608
St. Lucie	3614	3485	253014	243923	1458
Santa Rosa	81	19	5671	1392	164
Seminole	2742	344	191955	24108	690
Sumter	1002	71	100211	7110	492
Suwannee	7	7	489	535	128
Taylor	8	7	551	520	163
Volusia	7434	1204	520387	84264	2072
Wakulla	0	2	3	181	13
Walton	141	53	9880	3691	241
Washington	2	2	136	116	15
Totals	115324	45073	8198306	3158108	47401

Total acreage in citrus groves..... 160,397

Total number of grove trees.....11,356,414

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In the table given, oranges and grapefruit are not listed separately. It is generally conceded that oranges occupy approximately 65 per cent. of the citrus acreage and grapefruit, limes and lemons the remaining 35 per cent. A careful and complete inspection of the Florida Keys, under the direction of District Inspector A. L. Swanson, during the winter of 1917-'18, revealed 2,341 acres of limes and lemons on the Keys.

A statement appearing in the February, 1919, issue of the California Citrograph, a magazine devoted to the citrus industry of California and the official organ of the California Citrus Exchange, gives the acreage planted to oranges and grapefruit in California as 172,604. This is only a little over 12,000 acres more than is devoted to these fruits in Florida and is a much smaller difference than is generally supposed. However, the lemon plantings in California, exceeding 48,000 acres, give California a marked surplus over Florida when the total of all citrus fruits are concerned. The acreage devoted to lemons in Florida is practically negligible.

THE POTATO WART DISEASE

H. E. Stevens

Potato wart is a serious disease in many of the European potato producing countries. Little was known of the disease prior to 1896, when it was first described and reported from Hungary. Since that date it has become widely distributed, invading many of the principal potato producing sections of the world. The persistent and destructive nature of this disease at once classes it as one to be avoided.

Since the first authentic report of potato wart in 1896, the disease has made rapid progress in Europe. It was reported in England in 1902. However, the disease was known to potato growers in certain districts long before this. It is a serious factor in the production of potatoes in many sections of England today. In 1908 the disease was found in several districts in Germany and had reached Ireland, where it was reported as doing considerable damage. Later, it spread to Scotland and Wales, and finally crossed the Atlantic to the shores of America. Wart was discovered in New Foundland in 1909, and recently, in 1918, specimens of this much dreaded disease were found in Pennsylvania. Thus, in little more than a decade, this newly discovered disease has spread through the principal potato grow-

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ing sections of Europe and has gained an entrance into the United States.

Will the disease spread rapidly over this country and soon become an added burden to the potato grower? We trust not. We should see to it that it does not spread. The potato crop as a whole is burdened with about all the troubles it can well stand, consistent with economic production. The diseases common to the potato in this country are sufficient to cause a large annual loss to the potato crop, these losses being estimated at about $60,000,000.00. The number of diseases common to the potato in the United States is already far too large and new ones should be avoided, especially those of foreign origin. They generally prove more disastrous and more difficult to control.

Apparently, the introduction of potato wart into the United States is not yet a serious matter if proper steps are taken. Thus far the disease has only been found in a few remote districts in back yard gardens. These districts are more or less isolated from the large agricultural centers, especially those devoted to potato growing, and there is perhaps still an opportunity to wipe this pest out before it gains a foothold in our potato producing centers.

The Federal Quarantine Board was quick to act as soon as it realized the serious nature of this disease and the results of its ravages in Europe. In 1912 a quarantine was placed on all potatoes coming into the United States from countries where potato wart was known to exist. This quarantine should prevent the further introduction of this disease into the United States—but again we have apparently locked the barn door after the horse was stolen. Prior to the establishment of this quarantine in 1912, large quantities of potatoes were imported from European countries to New York, Boston and Philadelphia for table use. It was considered improbable that any infectious disease from such potatoes would ever reach the potato producing centers, since this stock would be consumed in the larger cities, away from the agricultural districts. As a means of seed tubers it is generally conceded that the European varieties are not well adapted to the United States and the foreign seed is unprofitable from a commercial viewpoint. Hence, there would be no incentive for commercial potato growers to use such stock for planting. This appeared to be a logical view of the situation and, apparently, little if any of these foreign potatoes were used in commercial plantings. The potato wart has not yet been reported

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from our principal potato producing centers, and it is reasonable to suppose that such districts are yet free. It could not well be present without being detected.

There were other means, however, for the introduction of this disease into this country that were not taken into account and as a result, we have a few established centers of potato wart, from which the disease may eventually spread to the potato growing sections. If all the foreign potatoes that came into New York, Boston and Philadelphia had been consumed in those cities the chances for distributing any serious pest on such stock would have been very remote. It was learned, however, that much of this stock was redistributed to interior points, going as far west as St. Louis, and south to New Orleans. Some of it may have been redistributed again and again, reaching the small towns and villages and coming nearer to the potato growing sections of the country. This redistribution has been the menace. It is not to be supposed that all of the foreign potatoes shipped to this country were diseased ones, but since these potatoes were sold for eating purposes, few precautions would naturally be taken to cull out the diseased ones or treat those that might carry disease germs. It can be taken for granted that anything that would sell for a potato was shipped.

The first report of potato wart in the United States came from a little village in the mining districts of Pennsylvania. The specimens were obtained from a back yard garden. Other back yard gardens were examined and more of the disease was found. Other villages and towns were found to contain the disease in back yard gardens, until twenty-seven towns and villages were reported as having potato wart. In some cases the infection was severe and probably of several years' standing. This points back to foreign potatoes that were shipped into the United States prior to the quarantine of 1912. This infection undoubtedly came from foreign potatoes that were used as seed, and was the result of redistribution from Philadelphia, Boston or New York. Why the disease was not reported sooner may be explained by the fact that the infected villages and towns were inhabited chiefly by foreigners who know perhaps little of the English language.

This is just the beginning of the Federal search for this disease and represents only a small area in Pennsylvania. What will be found in other states that have received shipments of these foreign potatoes remains to be seen.

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The situation is brought nearer home to us here in Florida. I am informed that four cities in this State received shipments of these foreign potatoes prior to 1912. These were Jacksonville, Tampa, Key West and Pensacola. It is problematic how widely these potatoes were distributed from these cities.

It is customary for the back yard gardener to plant as seed potatoes those he may buy from his grocer, or the peelings from the potatoes used on his table. There has also been a great increase in the number of back yard gardens during the past few years and many potatoes have been planted in them. How many of such potatoes were infected with potato wart, and how many back yard gardens in Jacksonville, Tampa and Pensacola are infested with the potato wart organism?

This question should interest the Florida potato grower. This organism lives for six or eight years in the soil and rapidly increases when potatoes are grown in this infected soil. It is but a step from Jacksonville to the Hastings district. Just how serious this disease may become in Florida if once established is a matter of conjecture at the present time. Diseases of foreign origin usually prove more troublesome than our native pests, and the Florida potato grower should not willingly add this one to his burden. Again, our climatic conditions might be such that the disease would do little injury here, but the experiment of trying this out would be a risky one. The State is just passing through a costly experience with one foreign disease—citrus canker. This should serve as a lesson to keep out, or stamp out, any new invader before it becomes widely distributed. The method of combating potato wart is generally conceded to be prevention rather than remedial measures.

If the disease is present in any back yard garden in Florida it may become a menace to the potato industry of the State. If it does exist here we should discover it as soon as possible. If it does not, we can feel fortunate. A survey of the State is contemplated in the near future. The back yard gardener who grows potatoes, or any other person interested in the potato industry of Florida, can give valuable help in this search for the disease. When you dig potatoes from your garden keep this wart disease in mind and report or send in any suspicious looking specimens. Specimens for examination may be sent to the Agricultural Experiment Station, Gainesville, or the U. S. Department of Agriculture, Washington, and a report will be made on the same.

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APPEARANCE.—The disease may be easily recognized by the warty outgrowths on the tubers and under ground stems. Infections on the tubers usually start at the eyes, but may occur at other points on the surface. The warts vary greatly in size, and stand out prominently on the surface. They may range from smaller than a pea to as large as a walnut. The older warts are dark brown to black in color. In severe cases the entire tuber may be converted into a spongy, warty mass.

The disease is caused by the fungus *Chrysophlyctis endobiotica*. The fungus may live for seven or eight years in soil after it is thoroughly infected.

BERTRAM O. GASTON

It was with deepest sorrow that the members of the Plant Board staff learned of the death of Inspector Bertram O. Gaston, one of the most valued and reliable men on our force. His death occurred at Kissimmee, Florida, on January 17, 1919, as a result of pneumonia, following influenza.

BERTRAM O. GASTON

Mr. Gaston was born in Lowndes County, Georgia, May 3, 1891. His parents moved to Florida when he was four years of age. After completing his grammar school education he entered, at the age of 16, the employ of the Glen Saint Mary Nurseries. Later he went to Homestead, Dade County, and there engaged in the nursery business and was there when citrus canker made its appearance. Recognizing the impending calamity, Mr. Gaston vigorously took up the fight against this disease, enlisting as one of the first volunteer citrus canker inspectors under the Florida Growers' and Shippers' League in 1914. From then until his untimely death his energies and

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efforts were unstintingly given to combating this foe of the citrus industry. Appointed as an inspector of the State Plant Board in May, 1915, he rose to the position of foreman and later to that of district inspector. While in the latter position he demonstrated his ability by cleaning up one of the severest canker infections found in northern Florida.

On December 31, 1916, Mr. Gaston was married to Miss Donia Clark of Monticello, Florida.

Not content with taking the husband, the grim reaper, on February 12, 1919, took the infant son of Mr. and Mrs. Gaston. To the devoted wife and mother, in her double affliction, our hearts go out in deepest sympathy.

QUARANTINE DEPARTMENT

REPORT ON INSPECTIONS AND INTERCEPTIONS, ALL PORTS AND STATIONS, FOR THE QUARTER ENDING MARCH 31, 1919*

SHIPS INSPECTED:			
From foreign ports	410		
From U. S. ports other than Florida	171		
From Florida ports	372		
Total		953	
NUMBER OF PARCELS INSPECTED:			
Arriving by water:			
Passed	9824½		
Treated and passed	2928		
Returned to shipper	870		
Contraband destroyed	333½		
Total		13956	
Arriving by land—Express, Freight, Wagon, etc.:			
Passed	6260¾		
Treated and passed	26		
Returned to shipper	60		
Contraband destroyed	47¼		
Total		6394	
Arriving by mail:			
Passed	1894		
Treated and passed	533		
Returned to shipper	10		
Contraband destroyed	23		
Total		2460	
GRAND TOTAL OF PARCELS INSPECTED			22810
Total parcels passed		17979¼	
Total parcels treated and passed		3487	
Total parcels returned to shipper		940	
Contraband destroyed		403¾	
Total			22810

*Compiled by J. H. Montgomery, Quarantine Inspector, and A. C. Brown, Asst. Quarantine Inspector.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

ASSOCIATE EDITORS.

E. W. BERGER.....*Entomologist*
F. M. O'BYRNE.....*Nursery Inspector*
FRANK STIRLING.....*General Inspector*
J. H. MONTGOMERY.....*Quarantine Inspector*
H. E. STEVENS.....*Consulting Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING MARCH 31, 1919*.

Citrus grove trees inspected	2,243,941
Citrus nursery trees inspected	10,376,055
Inspectors employed	165
New properties showing infection	0
Total properties showing active infection	1
Grove trees found infected	1
Nursery trees found infected	0
Counties in which active infections were found	1

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,724
Nursery trees found infected since May, 1914	342,254
Number properties infected to March 31, 1919	480
Properties declared no longer "danger centers"	475
Properties still classed as "infected" March 31, 1919	5

*Compiled by Mr. Frank Stirling, General Inspector.

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The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1919:

1914		1915		1916		1917		1918		1919	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1
		Apr.	408	Apr.	49	Apr.	169	Apr.	2		
May	108	May	1042	May	338	May	52	May	1		
June	160	June	772	June	450	June	45	June	10		
July	275	July	651	July	349	July	39	July	0		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0		
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0		
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0		

NEW FEDERAL PLANT QUARANTINE.—The attention of Florida growers and nurserymen is directed to the fact that on June 1, 1919, a new Federal quarantine goes into effect. This quarantine is known as No. 37. It is intended to, and will, more fully protect the horticultural and agricultural interests of this country and is the result of much time and effort upon the part of experts of both the Federal Government and the various State Governments. Special quarantines prohibiting entirely the importation of specific plants and plant products from certain specified countries or places remain in effect.

Regulations have been prepared supplemental to Quarantine No. 37 governing the importation of nursery stock, etc., into this country. Under these regulations importation of material for propagation can only be made under permits issued by the Federal Horticultural Board.

Those contemplating importing plants or plant products intended for or capable of propagation should communicate with the Secretary of the Federal Horticultural Board, Washington, D. C., requesting blank forms of application for permits and other detailed information. At the time of writing indicate the nature and quantity of the material to be imported, the use for which it is intended and the place of export. This information may serve to indicate to the Board whether or not permits can be issued under the provisions of the quarantine and the regulations.

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A NEW WHEAT DISEASE.—Now it is a new disease of wheat, known as "Take All*", that has made its appearance in the United States. It is said to be very destructive to the wheat crop and has already been found in Illinois and several other places in the middle west. It is supposed to have become established by reason of farmers planting some of the Australian wheat which was imported early in the war for food purposes.

The desire to "try" seeds and plants from out of the way parts of the earth seems to be a mania afflicting, in greater or less degree, the entire human race. Countless pests and diseases have been brought to the United States with seeds and plants brought back by returning travelers. Annually the toll levied by these pests grows larger and annually larger and larger appropriations must be made to combat them.

Just another instance going to show the value and necessity of adequate and efficient plant quarantine service, both state and national.

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*Ophiobolus graminis.

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THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by
STATE PLANT BOARD OF FLORIDA
GAINESVILLE, FLA.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

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THE QUARTERLY BULLETIN

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HOST LIST OF THE FLUTED, OR COTTONY CUSHION-SCALE

G. B. MERRILL, Asst. Entomologist

The following is a list of plants from which the Cottony Cushion or Fluted Scale, *Icerya purchasi* Maskell, has been taken, and is compiled from the references given at the end of this paper.

Due credit is given to Mr. E. R. Sasscer, Chief Inspector, Federal Horticultural Board, U. S. Department of Agriculture, for having added materially to the list from the records at Washington, to Mr. Ernest R. Barber, Scientific Assistant, U. S. Bureau of Entomology, for his list of one hundred and thirty plants found infested in Louisiana, and to Mr. F. M. O'Byrne, Nursery Inspector of the State Plant Board, for a list of host plants taken from the records of his department and for valuable suggestions.

The writer is also indebted to Dr. E. W. Berger, Entomologist, State Plant Board of Florida, for his valuable assistance and advice and for going over the list and making corrections, and to Prof. P. H. Rolfs, Director of the Florida Agricultural Experiment Station, for examining approximately the first half of the paper for errors in the botanical nomenclature.

Absinthium (see *Artemisia absinthium* L.).
Acacia spp. c, e, f, g, h, i, l, t, u.
Acacia armata h.
Acacias, Australian g.
Acacia decurrens h.
Acacia decurrens var. *mollis* Lindl. (see *A. molissima).*
Acacia, False (see *Robinia pseudacacia).*
Acacia floribunda (Sidney Golden Wattle, variety of) i.
Acacia Julibrissin Willd. (see *Albizzia Julibrissin* Durazz.).
Acacia latifolia i.
Acacia limnoeris i.
Acacia melanoxylon (Australian Blackwood) (Blackwood acacia) g.
Acacia molissima Willd. i.
Acacia Nemu (see *Albizzia Julibrissin* Durazz.).
Acacia ornata u.
Acacia, Yellow (see *Robinia pseudacacia).*
Acalypha spp. p, v.
Acer sp. (Maple).
Achras sapota L. (Sapodilla).
Achyranthes sp. (see *Iresine sp.)* t.
Albizzia Julibrissin Durazz. *(Acacia Julibrissin* Willd.) *(Acacia Nemu* Willd.) z.
Alfalfa (see *Medicago sativa)* c, l.
Alligator-tree (see *Liquidambar styraciflua* L.).
Almond, Dwarf Flowering e, i, l.
Almond, Flowering (see *Prunus triloba)* t.
Althaea officinalis t.
Amaranth (see *Amarantus sp.).*
Amarantus sp. (Amaranth) e, l.
Amarantus retroflexus (Beet-root) (Red-root) (Careless Weed) i.
Ambrosia sp. c, e.
Ambrosia psilostachya e, l.
American Elder (see *Sambucus canadensis).*
American Holly (see *Ilex opaca).*
Amorpha fruticosa (Bastard Indigo) s.

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Anona u.
Antigonon leptopus (Rosa de Montana) (Mountain Rose) (San Miguelito) (Corallita) (Love's Chain) a.
Apple (see *Pyrus malus)* c, d, e, h, i, l, t.
Apricot (see *Prunus armeniaca)* c, d, i, l, t.
Aralia sp. w.
Aralia papyrifera (see *Tetrapanax papyriferum)* t.
Artemisia absinthium L. (Worm Wood) (Absinthium) b.
Artemisia ludoviciana (White Sage) (Western Mugwort) i, l.
Ascyrum sp. t.
Asparagus (see *Asparagus officinalis)* t.
Asparagus officinalis (Asparagus).
Aster t.
Aubergine (see *Solanum melongena* var. *esculentum).*
Australian acacias g.
Australian Blackwood (see *Acacia melanoxylon)* c, l.
Australian Silk Oak (see *Grevillea robusta).*
Australian Pine (see *Casuarina equisetifolia)* a.
Baccharis halimifolia t.
Bamboo, Wild (see *Smilax sp.).*
Banana (see *Musa sp.)* j.
Banyan, Wild (see *Ficus aurea).*
Bastard Indigo (see *Amorpha fruticosa).*
Bauhinia sp. (Mountain Ebony) (Orchid Tree).
Bay, Bull (see *Magnolia grandiflora).*
Bay *(Laurus nobilis)* w.
Bay, Rose (see *Nerium oleander).*
Bay, Sweet (see *Laurus nobilis)* t.
Bean t.
Bean, castor (see *Ricinus communis).*
Bearberry (see *Ilex decidua).*
Beefwood (see *Casuarina equisetifolia)* a.
Beet-root (see *Amarantus retroflexus).*
Beggarweed o.
Berberis sp. t.
Bermuda Grass (see *Cynodon dactylon) (Capriola dactylon,* Kuntze) c, d, l, t.
Bidens bipinnata L. (Spanish Needle) o.
Bidens pilosa i, l.
Bignonia sp. (Yellow Bignonia).
Bignonia, Yellow (see *Bignonia sp.)* t.
Bilsted (see *Liquidambar styraciflua* L.).
Birch, West Indian (see *Bursera Simaruba).*
Black Locust (see *Robina pseudacacia)* i.
Blackwood acacia (see *Acacia melonoxylon).*
Blackwood, Australian (see *Acacia melonoxylon).*
Blueberry (see *Vaccinum elliottii).*
"Blue-Gum" g.
Bottle Brush (see *Callistemon sp.)* g, l.
"Bottle-Brush" g.
Bougainvillea sp. a, g, l.
Bouvardia sp. t.
Box, Dwarf (see *Buxus sempervirens).*
Boxwood, c, l, t.
Bridal Wreath (see *Spirea cantoniensis)* i, l.
"Broom" u.
Broom, Spanish (see *Spartium junceum* L.).
Buddleia sp. t.
Bull Bay (see *Magnolia grandiflora).*
Bulnesia retano u.
Bumelia lanuginosa (Chittim Wood) t.
Bursera simaruba (Gumbo Limbo) (West Indian Birch) (Gum Elemi) a.
Buxus sempervirens (Dwarf Box).
Caladium t.
California Laurel (see *Umbellularia californica)* i.
California Pepper Tree (see *Schinus molle).*
Callicarpa americana (Spanish Mulberry).
Callistemon sp. (Bottle Brush).
Camphor (see *Cinnamomum camphora)* k, t.
Cane, Sugar (see *Saccharum officinarum* L.).
Canna sp. t.
Capriola dactylon, Kuntze. (see *Cynodon dactylon).*
Capsicum sp. (Pepper).
Careless Weed (see *Amarantus retroflexus).*
Carex spp. i, l.
Carica papaya (Papaya) (Pawpaw).
Carya pecan (Pecan).
Caryota urens (Toddy-palm) (Winepalm) (Fish-Tail Palm) l, m, u.
Cassia marylandica (Wild Senna) t.
Castor Bean (see *Ricinus communis)* c, e, i, l.

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Castor-oil plant (see *Ricinus communis).*
Casuarina equisetifolia (Australian Pine) a, l.
Casuarius g.
Catalonian (see *Jasminum grandiflorum).*
Cedar of Lebanon (see *Cedrus bibani)* c, l, t, u.
Cedrus bibani (Cedar of Lebanon).
Cedar sp. t.
Celtis sp. (Hackberry) (Sugar-berry) (Nettle Tree).
Cenchrus gracillimus (Sandspur) (Sand-bur) a.
Cereals u.
Chaetochloa sp. (Foxtail Grass).
Chenopodium album L. (Lamb's Quarters) (Pigweed).
Chenopodium murale L. i.
Chittim Wood (see *Bumelia lanuginosa).*
Chrysanthemum sp. c, l, t.
Chrysanthemum leucanthemum hybridum (Shasta Daisy).
Chrysolidocarpus lutescens l, m.
Cigar Plant (see *Cuphea tricolor)* t.
Cinnamomum camphora (Camphor).
Cinnamon vine (see *Dioscorea batatas)* t.
Citron (see *Citrus medica)* c, t.
Citrus (all species) a, d, t.
Citrus aurantium (Orange).
Citrus grandis (Grapefruit) (Pomelo).
Citrus limonia (Lemon).
Citrus medica (Citron) c.
Citrus sinensis (Orange).
Clematis sp. t.
Coco-grass (see *Cyperus rotundus)* t.
Cocoanut Palm (nuts only). (see *Cocos nucifera)* a, l.
Cocos nucifera (Cocoanut Palm).
Coffee Weed d.
Coleus a, l.
Common Mallow (see *Malva rotundifolia).*
Cone Flower (see *Rudbeckia sp.).*
Copper-leaf (see *Acalypha sp.).*
Corallita (see *Antigonon leptopus).*
Cork Elm (see *Ulmus racemosa)* i, l.
Corn (see *Zea mays)* t.
Cowpea (see *Vigina sp.)* b.
Crape Myrtle (see *Lagerstroemia indica).*
Crataegus sp. (Hawthorne) (Hawthorn).
Creeping Fig (see *Ficus pumila).*
Cuphea tricolor (Cigar Plant.
Cupressus sp. (Cypress).
Curly Dock (see *Rumex crispus).*
Cycas sp. t.
Cydonia oblonga (Quince).
Cynodon dactylon (Capriola dactylon, Kuntze.) (Bermuda Grass).
Cyperus rotundus (Coco-grass) (Nut-grass).
Cypress (see *Cupressus sp.)* c, f, h, i, l, t.
Daisy, Shasta (see *Chrysanthemum leucanthemum hybridum)* t.
Dandelion (see *Taraxacum officinale)* t.
Date Palm (see *Phoenix sp.).*
Dioscorea batatas (Cinnamon vine).
Dock, Curly (see *Rumex crispus).*
Dock, Yellow (see *Rumex Crispus).*
Dwarf Box (see *Buxus sempervirens)* i, l.
Dwarf Flowering Almond e, i, l.
Eagle Fern (see *Pteris aquilina* L.).
Ebony, Mountain (see *Bauhinia sp.).*
Eggplant (see *Solanum melongena* var. *esculentum)* t.
Elder, American (see *Sambucus canadensis).*
Elder, Sweet (see *Sambucus canadensis).*
Elderberry (see *Sambucus canadensis)* t.
Elm (see *Ulmus sp.)* t.
Elm, Cork (see *Ulmus racemosa).*
Elm, Rock (see *Ulmus racemosa).*
English Ivy (see *Hedera helix)* i, l.
English Walnut (see *Juglans regia)* c, l.
Epilobium coloratum (Willow Herb) i, l.
Erigeron canadensis i, l.
Escallonia bunda t.
Eucalyptus globulus (Blue-Gum).
Eucalyptus sp. i.
Euonymus t.
Euphorbia pulcherrima (Poinsettia).
False Acacia (see *Robinia pseudacacia).*
Fern (2 *spp.)* t.
Fern, Eagle (see *Pteris aquilina* L.).
Ficus aurea (Wild Banyan) a, l.
Ficus carica L. (Fig).
Ficus nitida (see *F. retusa)* t.
Ficus pumila (F. stipulata) (F. repens) (Creeping Fig).
Ficus repens (see *F. pumila)* t.
Ficus retusa.
Ficus stipulata (see *F. pumila).*
Fig (see *Ficus carica* L.) a, c, e, g, i, l, t.
Fig, Creeping (see *Ficus pumila).*
Firs u.

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Fish Tail Palm (see *Caryota urens*) l.
Flamboyant (see *Poinciana regia*).
Flowering Almond (see *Prunus triloba*) c, l.
Foxtail Grass (see *Chaetochloa sp.*) a, l.
Fragaria sp. (Strawberry).
Fruit Trees u.
Furze (see *Ulex europaeus* L.) h.
Genista juncea (see *Spartium junceum* L.).
Geranium c, l, t.
Geranium, Ivy.
Geranium, Rose e, i, l.
Goldenrod (see *Solidago sp,*) c, l, t.
Golden-chain (see *Laburnum sp.*).
Golden Willow, g.
Gorse (see *Ulex europaeus* L.) h.
Grape (see *Vitis sp.*) a, c, e, i, l, t.
Grapefruit (see *Citrus grandis*) c.
Grass f, l.
Grass, Bermuda (see *Cynodon dactylon*).
Grass, Foxtail (see *Chaetochloa sp.*).
Grass, Johnson (see *Holcus halepense* L.).
Green Wattle (see *Acacia decurrens*).
Grevillea robusta (Silk Oak) (Australian Silk Oak) t.
Guava (see *Psidium guajava* L.).
Guinea squash (see *Solanum melongena* var. *esculentum*).
"Gum, Blue" (see *Eucalyptus globulus*).
Gum Elemi (see *Bursera simaruba*).
Gum, Red (see *Liquidambar styraciflua* L.).
Gum, Star-leaved (see *Liquidambar styraciflua*).
Gum, Sweet (see *Liquidambar styraciflua*) t.
Gumbo Limbo (see *Bursera simaruba*) a, l.
Hackberry (see *Celtis sp.*) c, l, t.
Hakea g.
Haw, Possum (see *Ilex decidua*).
Hawthorn (see *Crataegus sp.*) g.
Hawthorne (see *Crataegus sp.*) l.
Hedera helix (English Ivy).
Helianthus spp. (Sunflowers) a, t.
Hibiscus spp. n, t.
Holcus halepense L. (Johnson Grass) (*Sorghum halepense* (L.) Pers.).
Holly, American (see *Ilex opaca*).
Holly Oak (see *Quercus ilex* L.) c.
Holm Oak (see *Quercus ilex* L.).
Honeysuckle (see *Lonicera sp.*). i, t.
Hop (see *Humulus sp.*).
Humulus sp. (Hop) u.
Hymenoplea salsola u.
Ilex decidua (Possum Haw) (Bearberry) t.
Ilex kingerana a.
Ilex opaca (American Holly) t.
Impatiens sp. (Lady-Slipper) (Touch-me-not) t.
Indian Jassmine g.
Indigo, Bastard (see *Amorpha fruticosa*).
Inga pulcherrima t.
Ipomoea sp. (Japanese Morning Glory).
Iresine sp. (see *Achyranthes sp.*).
Iron-weed (see *Vernonia sp.*) c, l, t.
Italian Jasmine (see *Jasminum grandiflorum*).
"Ivy" u.
Ivy, English (see *Hedera helix*) t.
Ivy Geranium.
Japanese Morning Glory (see *Ipomoea sp.*).
Japanese Pittosporum (see *Pittosporum tobira*).
Japanese Plum (see *Prunus salicina*) t.
Japanese Yew (see *Podocarpus sp.*).
Jasminum grandiflorum (Italian Jasmine) (Royal Jasmine) (Spanish Jasmine) (Catalonian) t.
Jasmine, Italian (see *Jasminum grandiflorum*).
Jasmine, Royal (see *Jasminum grandiflorum*).
Jasmine, Spanish (see *Jasminum grandiflorum*).
Jassmine, Indian g.
Jew, Wandering (see *Zebrina pendula*).
Johnson Grass (*Holcus halepense* L.) (*Sorghum halepense* L.) t.
Juglans spp. (Walnuts).
Juglans regiae (English Walnut) (Persian Walnut).
Kangaroo Thorn (see *Acacia armata*).
Knotweed (see *Polygonum sp.*) c, l.
Kudzu (vine?) (see *Pueraria hirsuta*) t.
Laburnum sp. (Golden-chain) i.
Lady-Slipper (see *Impatiens sp.*) t.
Lady's Thumb (see *Polygonum persicaria*).
Lagerstroemia indica (Crape Myrtle).
Lamb's Quarters (see *Chenopodium album* L.) c, l, t.
Lantana sp. t.
Laurel (see *Laurus nobilis*) c, l, t.
Laurel, California (see *Umbellularia californica*).

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Laurel Oak (see *Quercus laurifolia)* c.
Lauroceracus caroliniana u.
Laurus nobilis (Laurel) (Sweet Bay) c, u.
Laurestinus (see *Viburnum tinus* L.).
Laurustinus (see *Viburnum tinus* L.) g.
Leadwort (see *Plumbago sp.).*
Legume u.
Lemon (see *Citrus limonia)* c, f, h.
Leptomera acida u.
Lettuce, Wild (see *Letuca sp.)* t.
Letuca sp. (Wild Lettuce).
Ligustrum sp. (Privet).
Lime, Spanish (see *Melicocca bijuga* L.).
Liquidambar styraciflua L. (Sweet Gum) (Red Gum) (Bilsted) (Star-leaved Gum) (Alligator-tree).
Liriodendron tulipifera (Tulip-tree) (White Poplar) t.
Locust c, e, i, l, t.
Locust, Black (see *Robinia pseudacacia).*
Loggerhead Breast (see *Phyllanthus sp.)* a, l.
Lonicera sp. (Honeysuckle).
Love Entangle (see *Sedum acre).*
Love's Chain (see *Antigonon leptopus).*
Magnolia sp. c, e, l, t.
Magnolia grandiflora (Bull Bay) i.
Mallow, Common (see *Malva rotundifolia).*
Malva rotundifolia (Common Mallow) i, l.
Maple (see *Acer sp.)* t.
Marsh Mallow (see *Alhaea officinalis).*
Mastic-tree, Peruvian (see *Schinus molle).*
Medicago denticulata i, l.
Medicago sativa L. (Alfalfa).
Melicocca bijuga (Spanish Lime).
Mentha piperita (Peppermint).
Mentha pyserifera.
Mentha spicata (Spearmint).
Mimosa tree (see *Albizzia Julibrissin Durazz).*
Mimosa spp. t.
Morella cerifera (Myrtle) (Wax Myrtle) *(Myrica cerifera).*
Morning Glory, Japanese (see *Ipomoea sp.)* t.
Morus spp. (Mulberries).
Mountain Ebony (see *Bauhinia sp.)* r.
Mountain Rose (see *Antigonon leptopus).*
Mugwort, Western (see *Artemisio ludoviciana).*
Mulberries (see *Morus spp.)* d, l, t.
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Nettle (see *Urtica sp.)* c, e, l, t.
Nettle Tree (see *Celtis sp.).*
Nightshade (see *Solanum nigrum)* c, e, l, t.
Nut-grass (see *Cyperus rotundus).*
Oak, Australian Silk (see *Grevillea robusta).*
Oak, Holly (see *Quercus ilex* L.) c.
Oak, Holm (see *Quercus ilex* L.).
Oak, Laurel (see *Quercus laurifolia).*
Oaks (see *Quercus spp.)* g, l, t.
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Opopanax u.
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Orchid Tree (see *Bauhinia sp.).*
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Palm, Date (see *Phoenix sp.)*
Palm, Fish Tail (see *Caryota urens).*
Panicum crus-galli i, l.
Papaya (see *Carica papaya)* n.
Papyrus antiquorum t.
Paradise Tree (see *Simaruba glauca)* a.

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Paspalum spp. i, l.
Papaw (see *Carica papaya).*
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Peacock Flower (see *Poinciana regia).*
Pear (see *Pyrus sp.)* c, d, i, l, t.
Pecan (see *Carya pecan)* c, e, l, t.
Pepper (see *Capsicum sp.)* c, e, i, l, t.
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Pepper Tree, California (see *Schinus molle).*
Persian Walnut (see *Juglans regia).*
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Peruvian Mastic-tree (see *Schinus molle* L.).
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Pittosporum sp. c, g, l, t.
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Prosopis sp. u.
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Prunus caroliniensis t.
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Prunus salicina (Japanese Plum).
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Zea mays (Corn).
Zebrina pendula (Wandering Jew) *(Tradescantia fluminensis).*

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

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Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING JUNE 30, 1919*.

Citrus grove trees inspected	1,821,704
Citrus nursery trees inspeced	13,390,251
Inspectors employed	156
New properties showing infection	1
Total properties showing active infection	2
Grove trees found infected	2
Nursery trees found infected	0
Counties in which active infections were found	1

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,726
Nursery trees found infected since May, 1914	342,254
Number properties infected to June 30, 1919	481
Properties declared no longer "danger centers"	475
Properties still classed as "infected" June 30, 1919	6

*Compiled by Mr. Frank Stirling, General Inspector.

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The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1919:

1914		1915		1916		1917		1918		1919	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1
		Apr.	408	Apr.	49	Apr.	169	Apr.	2	April	1
May	108	May	1042	May	338	May	52	May	1	May	1
June	160	June	772	June	450	June	45	June	10	June	0
July	275	July	651	July	349	July	39	July	0		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0		
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0		
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0		

QUARANTINE DEPARTMENT

Report on Inspections and Interceptions, All Ports and Stations, for the Quarter Ending June 30, 1919*

Ships and Vessels Inspected:			
From foreign ports	501		
From U. S. ports other than Florida	225		
From Florida ports	222		
Total		948	
Number of Parcels Inspected:			
Arriving by water:			
Passed	35645		
Treated and passed	110		
Returned to shipper	445		
Contraband destroyed	406		
Total		36606	
Arriving by land—express, freight, wagon, etc.:			
Passed	1056¾		
Treated and passed	7		
Returned to shipper	10		
Contraband destroyed	22¼		
Total		1096	
Arriving by mail:			
Passed	1141		
Treated and passed	44		
Returned to shipper	20		
Contraband destroyed	10		
Total		1215	
Total Number of Parcels Inspected			38917

Disposition of Parcels Inspected

Total Parcels Passed	37842¾	
Total Parcels Treated and Passed	161	
Total Parcels Returned to Shipper	475	
Contraband Destroyed	438¼	
Total		38917

*Compiled by Dr. J. H. Montgomery, Quarantine Inspector.

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BEE DISEASE ERADICATION.—During the session of the Legislature, recently closed, a bill was introduced by Representative Thos. C. Ray, of Calhoun County, providing for the prevention and eradication of diseases of honey bees in Florida. This bill became a law and is now designated as Chapter 7938, Laws of Florida.

Honey bees are attacked at times by a number of different diseases, one of which, "American foul brood", is extremely destructive. In fact to the beekeeping industry this disease is as much of a terror as is citrus canker to the orange grower. The disease is caused by an organism, *Bacillus larvae*, which destroys the "brood" or larval stages of the bee, resulting in the colony being rapidly weakened and finally killed out entirely.

The Act mentioned, carrying with it an appropriation of $5,000 per annum, is of great importance to the beekeepers of Florida, for without protection against infectious diseases the bee and honey industries will not only fail to survive but, what is of even greater importance, future development along these lines will be made impossible.

From the standpoint of natural conditions, Florida is one of the best states in the Union for profitable beekeeping. The industry is only beginning to be developed and, fortunately, it appears that but little disease has thus far been introduced.

The execution of the new law is placed in the hands of the State Plant Board and work is already under way in eradicating American foul brood in two of the western Florida counties.

The Plant Commissioner is particularly anxious to have the names and addresses of all beekeepers in Florida and to have them report to him all cases of bee disease coming to their attention.

Copies of the bee disease act, together with rules and regulations made by the State Plant Board in connection therewith, can be secured by writing the Plant Board at Gainesville.

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THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by
STATE PLANT BOARD OF FLORIDA
GAINESVILLE, FLA.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. IV OCTOBER, 1919 No. 1

THE EUROPEAN CORN BORER

Insect Established in New England and New York Regarded as Menace to the Corn Crop of the United States

WILMON NEWELL

What is regarded by entomologists as one of the most serious insect pests yet found in the United States has occupied an area of 1400 square miles near Boston, Mass., an area of about 200 square miles on Cape Cod and still another area of 300 square miles at Schenectady, New York. This insect is the European corn borer, *Pyrausta nubilalis* Hubner, and it threatens to do more damage, in the aggregate, than any pest with which the farmers or fruit growers of America have yet had to contend. Already the States of Massachusetts and New York have each expended nearly $100,000.00 in fighting it, the U. S. Department of Agriculture is using a Congressional appropriation of $250,000.00 for the same purpose, appropriated by Congress in August, 1919. The Department is asking for an additional appropriation of $500,000.00 and a conference of State Commissioners of Agriculture and Official Entomologists, held at Albany, N. Y., and Boston, Mass., on August 28th and 29th has recommended to Congress that $2,000,000.00 be appropriated at once to combat the pest, with the additional appropriation, later, of as many more millions of dollars as may be necessary.

OF IMPORTANCE TO FLORIDA

Although the European corn borer is, as yet, not known to occur in this country, outside of New England and New York State, its rate of spread during the past three seasons has been so alarming and the means by which it may be spread through commercial channels are so numerous that every state in the Union is vitally interested in the pest being eradicated, or at least confined to the territory it already occupies. It would undoubtedly do greater damage in Florida than it now does in

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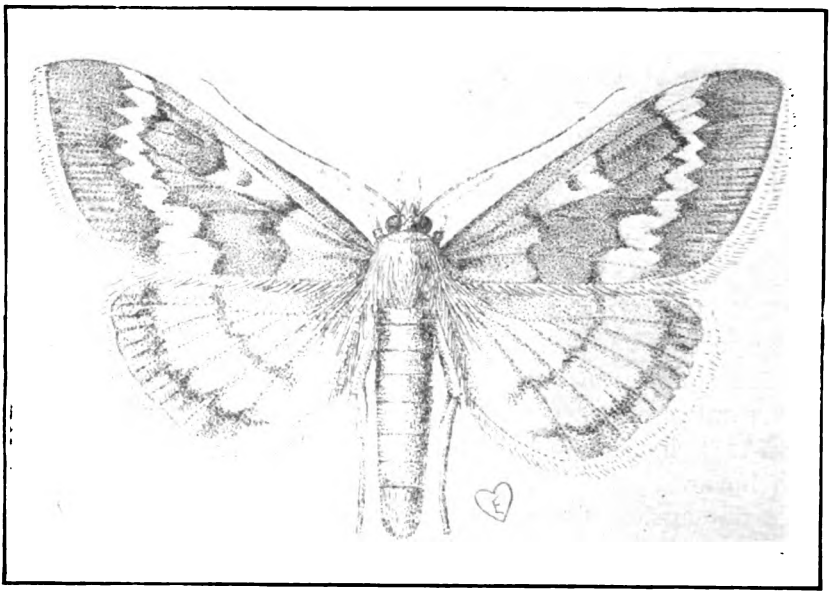
the extreme northeastern states, as a consideration of the following information will show.



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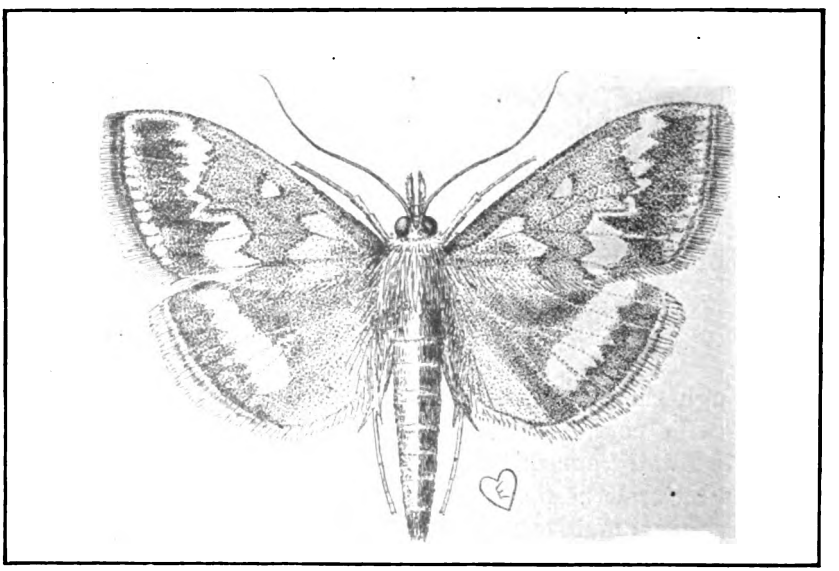

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Fig. 1.—The European corn borer: a, female moth; b, male moth (After Caffrey, Farmers Bulletin 1046, U. S. Dept. of Agr.).

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Nature of the Insect

The adult is a small, yellowish moth. The female deposits eggs on the leaves of corn and, in fact, of nearly all vegetation except forest and fruit trees. At the Bureau of Entomology Laboratory at Arlington, Mass., it has been found that the females lay an average of 385 eggs each and the maximum number deposited by one female was 777! The larvae, or borers, hatching from these eggs feed at first on the outside of the foliage or plant and then burrow into the stalk or stem. In the case of corn they tunnel their way through all parts of the plant except the small fibrous roots. Not content with burrowing through the stalk of the corn, the larvae eat their way through the stem of the ear into the heart of the cob and often through the side of the cob to the kernels. At other times they leave the inside of the stalks and crawl over the outside of the plant, cutting off the tassel or eating their way, through the shucks, into the ear. They may even feed for a time on grasses and then return to corn or other crops. While corn is the favorite food plant of the insect in Massachusetts it has been found to attack no less than 48 other plants, among which are the following: grasses of various kinds, asparagus, barley, beans, beets, cabbage, chrysanthemum, celery, goldenrod, grapevine, Hungarian millet, lettuce, oats, pigweed, pepper, potatoes, ragweed, Swiss chard, spinach, sunflower, thistle, tomatoes and wheat.

In Massachusetts there are two generations of the insect a year. Overwintering larvae transform to moths about the middle of May and these deposit eggs for the next generation of larvae. The moths from these begin to reach maturity during July and August and deposit eggs which hatch into larvae that, for the most part, do not complete their development before winter. They remain in the stalks of corn, in corn cobs and in the stems of various weeds and grasses until the following spring, when their development is completed.

Rapid Spread of the Pest in New England

The European corn borer was first found in the United States in the summer of 1917, near Boston, by Mr. S. C. Vinal, an agent of the Bureau of Entomology engaged in the study of truck crop insects. Identification of the insect showed it to be identical with the corn borer of Europe, a pest known to occur through central and southern Europe, west central and northern Asia,

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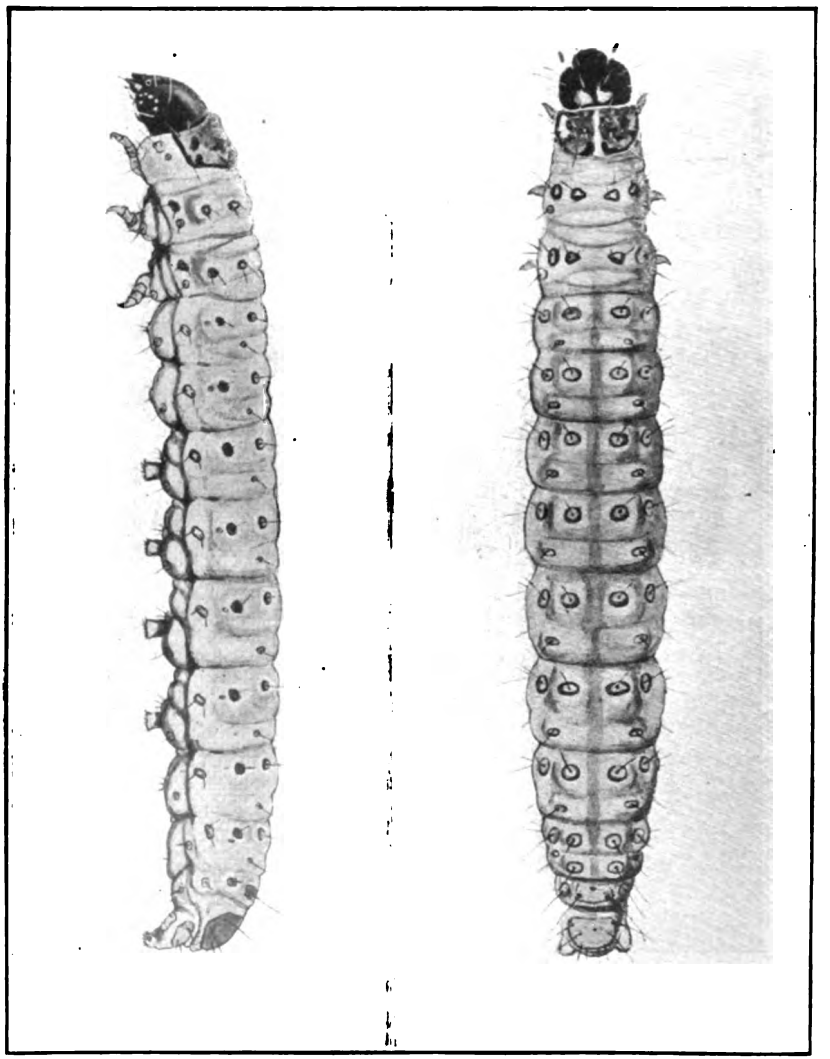
China, Japan and the Philippine Archipelago*. As the insect is known to attack hemp in Europe and as considerable hemp had been imported for use by cordage factories near Boston, it



a b

Fig. 2.—Full-grown larvae of the European corn borer: a, lateral view; b. dorsal view (After Caffrey, Farmers Bulletin 1046, U. S. Dept. of Agr.).

was assumed that the insect had become established through the importation of infested hemp.

*Bulletin 189, Massachusetts Agr. Exp. Station.

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In 1917 the infested area near Boston covered about 100 square miles. By the latter part of 1918 this area had increased to 400 square miles and at the present writing covers not less than 1600 square miles. In addition to this area, another infestation, covering about 200 square miles, has been found on Cape Cod, the occurrence of the pest at this point undoubtedly having been due to the shipment of "roasting ears" from Boston to a resort hotel on the Cape. The insect was also discovered near Schenectady, New York, in January, 1919. This infested area covers about 300 square miles.

The adult moths are good fliers and are also blown considerable distances by the winds. This explains in part the rapid spread of the insect in localities where it has become established. The spread, however, is augmented greatly by the movement and shipment of green corn, ripe corn on the ear, corn fodder, straw and similar materials from the infested districts.

No Satisfactory Means of Control

Owing to the rapid rate of increase of the insect and its habit of feeding inside of plants all ordinary measures for control of crop pests are ineffective. The most practical measure that suggests itself is of course the destruction during the winter of all corn stalks, weeds, etc., in which the larvae are hibernating and this is, in fact, the method being employed in the infested districts in the attempt to subdue the insect. However, in ordinary farm practice such a method would be prohibitive in its cost as, to be effective, it would involve the burning of all corn cobs, fodder, corn stalks and corn stubble, as well as all straw, hay, weeds and grass on the farm. It is also significant that in the infested area in the Mohawk Valley, in New York, where the State spent thousands of dollars last spring in the effort to destroy every particle of corn stubble and vegetation the pest is now as abundant as it probably was a year ago. Where similar methods have been employed in Massachusetts they have failed to bring about any appreciable decrease in the insects, although it is conceivable that without these measures the insects would be much more abundant now than they actually are.

Because the borer works for the most part inside of the plants, spraying with arsenical poisons, while destroying many larvae, cannot begin to offset the terrific rate of reproduction.

Plowing under of infested plants is also ineffective. Infested corn stalks buried last fall to a depth of one foot were found,

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when dug up the past spring, to contain healthy larvae and moths were able to issue through nine inches of dirt from infested stems that had been buried. A few parasites are known to

Fig. 3.—Typical injury to stalk of corn by larvae of the European corn borer, showing entrance to burrow of the larvae and extruded "frass" or refuse (After Caffrey, Farmers Bulletin 1046, U. S. Dept. of Agr.).

attack the insect but they have not thus far brought about any perceptible diminution of the borers. The rate of increase of the

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European corn borer is in fact so great that any natural or artificial control measure which destroys less than 98 per cent of each generation would have no effect upon the damage done by the insect. The progeny of one pair of moths can amount to 300,000 insects in a single season. The increase of the insect is therefore limited only by the amount of food which growing plants can provide for it and a large proportion of each generation could be destroyed without the damage to crops being in the least reduced.

DANGER TO THE SOUTH

There is nothing in the foreign distribution of the European corn borer, or in its habits, to indicate that it would be other than a most destructive insect in the warmer sections of the United States. There would undoubtedly be three or four generations here, as compared to two in Massachusetts. In addition, the insect would find a greater variety of plants here subject to its attack. For one thing it would doubtless find sugar cane as much to its liking as corn. This conclusion is reached because corn and cane are closely related, both being grasses and because many native insects of the South attack both corn and cane indiscriminately. In fact, nearly every corn infesting insect attacks cane and vice versa. The succulent and tender interior of sugar cane stems would afford ideal food for the borer and there is no telling, with several generations a year, how severely the borer would injure the cane crop.

The European corn borer has been found to attack cotton in Egypt. In Massachusetts it attacks, slightly, a number of vegetable crops and it is not impossible that under Florida climatic conditions it would prove an enemy of celery, tomatoes, beans, pepper or lettuce.

The possibility of this pest reaching Florida is more than a passing one. The larvae might be contained in corn fodder, corn on the ear or straw used as feed or bedding for livestock shipped from New England or New York to Florida points, they might be in celery, green corn, green string beans or other vegetables used on board vessels sailing direct from Boston to Florida ports, such as Jacksonville, in stems of such plants as chrysanthemums, grapevines, etc., shipped as nursery stock, in pieces of corn stalk, cobs or grain or weed stems contained in shipments of seed in bulk, in hay, grass or straw used as packing for crockery or glassware, or even in the stems of such cut flowers as chrysanthemums, gladiolas, dahlias, etc. shipped by New York and Boston florists to Florida during the tourist season.

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The shipment of all nursery plants which are known to be hosts of the corn borer has already been prohibited from the "infested" areas by the Nursery Inspector of the State Plant Board, and all dangerous packing material with nursery stock from such areas has also been prohibited. However any quarantine measure which would effectively prevent the introduction of the insect in shipments of cut flowers, green vegetables, grain, seed, fodder, etc. would have to be very complicated, would cause more or less inconvenience to travelers and business men and for complete enforcement would require a larger quarantine force than the State Plant Board now has. At the same time, it is probable that the Board will, at its next meeting, adopt quarantine rules looking to the elimination of this danger as far as the circumstances permit.

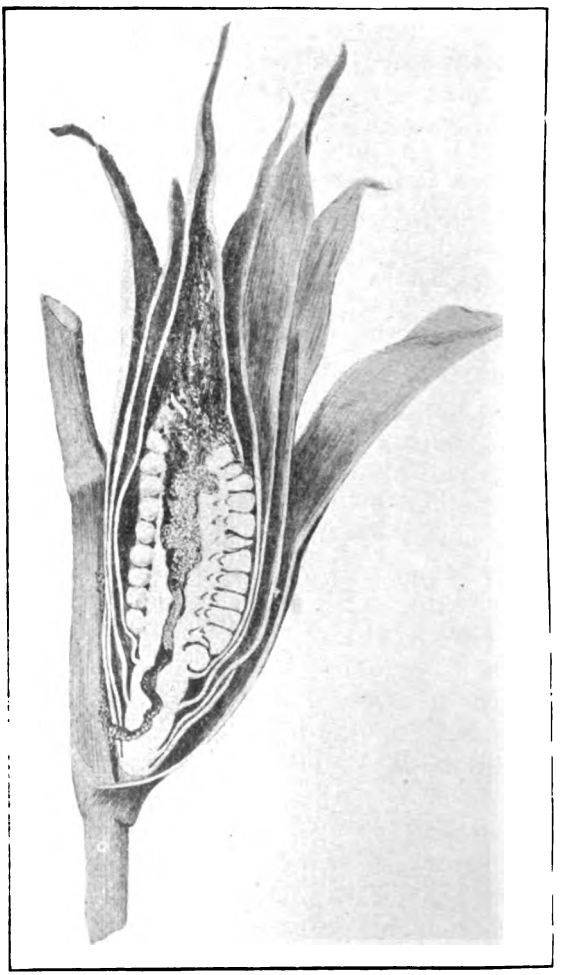

Fig. 4.—Longitudinal section of ear of sweet corn damaged by the European corn borer, showing entrance of larvae, the stem and cob (After Caffrey, Farmers Bulletin 1046, U. S. Dept. of Agr.).

What Should Be Done

The citizens of Florida can help protect the State against the introduction of this destructive insect. In the first place they should not have shipments made, from New England and New

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York State, of nursery stock, cut flowers, seed in bulk (uncleaned seed), or vegetables. In the second place every farmer and trucker in Florida should keep a sharp lookout for the pest in his neighborhood. Any spotted "worm" or larva found within the stems of corn, either green or dried, should be regarded with suspicion and specimens immediately sent to the State Experiment Station or the State Plant Board at Gainesville for identification. As corn is the favorite host plant of the insect it is almost a certainty that the insect will be found in corn stalks almost immediately after its introduction into a community.

The problem is too big for the State Plant Board to handle alone. The vigilance and cooperation of all citizens is necessary if this pest is to be kept out of Florida, or eradicated if it should, by any chance, get in.

The information contained in this article was secured through the personal investigations of the writer in Massachusetts and New York during August and September, 1919, and is confirmed in all essentials by Bulletin 189 of the Massachusetts Experiment Station and Farmers Bulletin No. 1046 of the U. S. Dept. of Agriculture.

THE BEE DISEASE ERADICATION WORK OF THE STATE PLANT BOARD

WILMON NEWELL

For many years Florida has been recognized by the beekeeping fraternity generally as being one of the best sections of the United States for bee and honey production. Not only do many sections of the State possess native plants which produce nectar in abundance, but the climatic conditions make possible the rearing of bees and queens for at least eight months of the year.

While beekeeping has been developed to a high state of perfection in a few counties, the State as a whole has been very backwards in recognizing the possibilities in this industry. Perhaps this has been due to the abundance of other opportunities seemingly more attractive to both newcomers and the older citizens. However, within the past two years interest in bees has been increasing very rapidly, as is evidenced by the receipt of many requests for information on the subject by the State Plant Board and the Agricultural Division of the University of Florida, more recently, by the organization of Boys' and Girls' Beekeeping Clubs under the direction of various County Agents.

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Honey bees, like all other creatures, are subject to certain diseases. While most of these diseases, in the case of the honey bee, are not so severe as to cause destruction of the colonies and can for the most part be rather easily cured or controlled, one disease, "American foul brood", is exceedingly malignant. In fact, in its virulence it may well be compared to anthrax in cattle, glanders in horses or cholera in hogs. The disease is caused by a bacterium, *Bacillus larvae,* which affects only the brood or larvae of the bees. Every larva which becomes infected dies, hence the colony rapidly becomes weakened by reason of few or no bees reaching maturity and eventually the colony dies out entirely. Bees never recover from the disease and the malady cannot be cured by the use of drugs. It is therefore a disease where prevention and eradication constitute the most effective measure to take against it.

The future of the beekeeping industry in Florida is very largely dependent on whether this disease can be eradicated and further introductions of it prevented. If the State can be kept free from the disease there is no reason why Florida's honey production should not within a few years reach a valuation of one million dollars annually.

Fortunately, present information indicates that there is a comparatively small amount of the disease in Florida, that is, in comparison to its prevalence in some of the northern states. It is also fortunate that the last session of the State Legislature passed a bee disease act (Chapter 7938, Approved June 9, 1919), providing for quarantines to keep diseased bees out of the State and empowering the State Plant Board to take all necessary steps looking to eradication of bee diseases within the State. For the latter purpose an appropriation of $5,000.00 per annum for two years was made.

The Act referred to requires all colonies of bees, and second-hand beekeeping equipment, shipped into Florida to be accompanied by an official certificate of inspection, or by a special permit issued by the Plant Commissioner upon satisfactory evidence that the bees are free from danger of infection. The only exception is in the case of bees shipped without combs or honey—the so-called "pound packages". These can be shipped into the State without certificate or inspection as there is no danger of such bees transmitting American foul brood. This requirement of the law will be strictly enforced. It has been given wide publicity through various journals devoted to bee-

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keeping and the general managers of all transportation companies operating in Florida have been given official notice concerning it. In addition, the various assistant quarantine inspectors of the Florida State Plant Board, located at all ports and principal junction points in the State, will be able to readily intercept any shipment of bees as to which these requirements have not been complied with. In fact, it is next to an impossibility for bees to be shipped into the State in violation of the law because of the thorough organization of the Board's quarantine service.

As the appropriation for the first fiscal year did not become available until July 1st, actual work in inspecting apiaries could not be commenced until after that date. At the July meeting of the Board Mr. C. E. Bartholomew of Orlando was appointed by the Board as Assistant to the Plant Commissioner in the bee disease eradication work. Mr. Bartholomew had charge, for several years, of the beekeeping experimental work in Iowa, was subsequently employed as beekeeping expert by the United States Department of Agriculture and in addition had had charge, in the West, of very large apiaries. The present Plant Commissioner is also experienced in this line of work as he had charge, for five years, of the bee disease eradication work in Texas.

At the July meeting of the Board it was also decided, as the appropriation was insufficient to take up apiary inspection work over the entire State, that attention should first be given to those areas where beekeeping investments were at their maximum or where there was reason for believing that American foul brood occurred.

The beekeeping area along the Apalachicola River and its tributaries, in the Counties of Franklin, Calhoun, Liberty, Gadsden and Jackson, was reported as having more or less infection by this disease. In this area the industry is highly developed, the beekeepers using the latest and most approved methods, the apiaries varying in size from forty to as high as two hundred colonies and the tupelo bloom affording a very reliable and satisfactory honey crop each spring. A rough estimate, based on figures supplied by local beekeepers, indicates that in the territory between Apalachicola and the Georgia-Florida line there are between 10,000 and 12,000 colonies and the annual production of Tupelo honey is probably not far from 1,000 barrels. Naturally, a territory capable of such honey production has long since been fully occupied by beekeepers and there is no room for more.

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In fact, in some parts of this area there are already too many apiaries for profitable returns and in much of the tupelo section the beekeepers find it necessary to move their apiaries further north, into Georgia and Alabama, during the summer and autumn months in order for the bees to secure sufficient honey to subsist on.

Manifestly, American foul brood could cause enormous losses in this area, so thickly congested with bees, and it was decided to take up the inspection and eradication work there. The beekeepers of this area had been largely instrumental in securing the passage of the bee disease act and were naturally anxious that the danger confronting them should be dealt with as quickly as possible.

On July 23rd Mr. Bartholomew and the writer proceeded to Calhoun County. Inspections of apiaries in the vicinity of Wewahitchka and Dalkeith were begun immediately. Later, Mr. C. F. Glenn of Wewahitchka was appointed by the Board as District Apiary Inspector and in the latter part of the month and during August assisted in the inspections. The writer continued inspection work in that vicinity until August 5th and Mr. Bartholomew until August 18th. Mr. Glenn has continued the inspection work since that time.

Up to September 30th, approximately 3800 colonies in Calhoun and adjacent counties had been inspected, with the result that eighteen colonies had been found infected with American foul brood. These were distributed through four apiaries. With the owners' permission the bees, brood, honey and combs in all the infected colonies were destroyed by burning and the hive-bodies, covers and bottom boards disinfected with the burning oil spray. The lack of a sufficient honey flow did not make it practical to administer the so-called "shaking" treatment by which, under suitable conditions, the queen and bees can be removed from the infected material and the colony thereby "cured". It was also considered inadvisable to permit the diseased colonies to remain in existence, even for a short time, owing to the danger of the infection being carried to large apiaries in the neighborhood. To the present writing there have been no recurrences of the disease in these apiaries or those adjoining them, so there is good reason for believing that the "clean-up" in these apiaries was effective.

It should be stated in this connection that during June, just prior to the approval of the Bee Disease Act, a rather large

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apiary in Calhoun County was found by the owner to be infected with American foul brood. The owners of this apiary burned up all colonies in the apiary voluntarily and without compensation, for the protection of their fellow beekeepers.

During September inspection was commenced in Franklin County, particularly at Apalachicola and along the lower stretches of the Apalachicola River, along Jackson's Old River and in the Lake Wimico neighborhood. This work was done by Mr. Bartholomew, assisted by Mr. J. P. Anthony, of Apalachicola.

On the whole, the inspections thus far made in the Apalachicola River territory indicate that, while American foul brood has gained a foothold there, it has not become so firmly established that it cannot be eradicated by steady, careful work, particularly as the Plant Board is enjoying, in this undertaking, the practically universal co-operation of all the beekeepers.

The major portion of the current year's appropriation of $5,000.00 will be required for the eradication work in the area mentioned and until the disease is eradicated, or until at least all infections have been located and gotten under full control, it will not be possible for the Board to take up the eradication of bee diseases in other portions of Florida: although there are reasons for believing that American foul brood occurs in at least three other sections. Were the Board to attempt to spread its work over the entire State, with the appropriation available, nothing really worth while would be accomplished in any one section. It seems best, therefore, to clean up one area at a time, doing the work with the utmost thoroughness.

Until such time as the Plant Board can extend this work to other parts of the State all beekeepers should inform themselves regarding the nature of foul brood, learn its symptoms and be on the lookout for it, promptly reporting to the Board at Gainesville any suspicious cases. Bulletins of the United States Department of Agriculture describing the more common bee diseases, including American foul brood, and copies of the Bee Disease Act of Florida and the rules of the State Plant Board, may be had free by addressing the writer of this article at Gainesville, Florida.

The Plant Commissioner is desirous of having the name and address of every beekeeper in Forida, regardless of whether he owns one colony or one thousand and beekeepers will therefore confer a favor by writing him, giving at the same time the number of colonies owned.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

ASSOCIATE EDITORS.

E. W. BERGER.....*Entomologist*
F. M. O'BYRNE.....*Nursery Inspector*
FRANK STIRLING.....*General Inspector*
J. H. MONTGOMERY.....*Quarantine Inspector*
H. E. STEVENS.....*Consulting Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING SEPTEMBER 30, 1919*.

Citrus grove trees inspected	1,027,316
Citrus nursery trees inspected	8,082,788
Inspectors employed	110
New properties showing infection	0
Total properties showing active infection	1
Grove trees found infected	1
Nursery trees found infected	0
Counties in which active infections were found	1

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,727
Nursery trees found infected since May, 1914	342,254
Number properties infected to September 30, 1919	481
Properties declared no longer "danger centers"	475
Properties still classed as "infected" September 30, 1919	6

*Compiled by Frank Stirling, General Inspector.

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The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to September 30, 1919:

1914		1915		1916		1917		1918		1919	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1
		Apr.	408	Apr.	49	Apr.	169	Apr.	2	April	1
May	108	May	1042	May	338	May	52	May	1	May	1
June	160	June	772	June	450	June	45	June	10	June	0
July	275	July	651	July	349	July	39	July	0	July	0
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0	Sept.	0
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0		

QUARANTINE DEPARTMENT

Report on Inspections and Interceptions, All Ports and Stations, for the Quarter Ending September 30, 1919

Among the notable interceptions made during the Quarter were the following:

Black fly *(Aleurocanthus woglumi)* was intercepted on Spanish lime from The Bahamas.

An important scale-insect, *Aspidiotus coccotiphagus,* was intercepted on palm from Cuba and another important scale, *A. destructor,* was taken on palms from both Cuba and the Isle of Pines. *A. orientalis* on palm, *A. sacchari* on sugar cane, *Pseudischnaspis alienus* on guava and palm and *Vinsonia stellifera* on sapodilla were also taken in material from Cuba.

The seed-infesting Hymenopteron, *Bephrata cubensis,* was taken in soursop from Cuba.

Ships and Vessels Inspected:

From foreign ports	538	
From U. S. ports other than Florida	272	
From Florida ports	187	
Total		997

Number of Parcels Inspected:

Arriving by water:		
Passed	53015	
Treated and passed	34503½	
Returned to shipper	401	
Contraband destroyed	429	
Total		88348½

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Arriving by land: express, freight, wagon, etc.:			
Passed	1927¼		
Treated and passed	7		
Returned to shipper	24		
Contraband destroyed	28¾		
Total		1987	
Arriving by mail:			
Passed	148		
Treated and passed	9		
Returned to shipper	13		
Contraband destroyed	1		
Total		171	
Total number of parcels inspected			90506½
Number of parcels on hand pending determination as to final disposition	7		

Disposition of Parcels Inspected

Total Number of Parcels Passed	55090¼	
Total Number Treated and Passed	34519½	
Total Number Returned to Shipper	438	
Total Number Contraband Destroyed	458¾	
Total Number of Parcels Inspected		90506½

BEE DISEASE ERADICATION

Report on Inspection and Eradication Work for the Quarter Ending September 30, 1919

Colonies of bees inspected	3,800
Colonies found infected with American foul brood	18
Number infected colonies destroyed, American foul brood	18
Number colonies found infected with European foul brood	3
Number of infected colonies treated, European foul brood	3
Number of colonies found infected with sacbrood	3

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EMPLOYEES OF THE STATE PLANT BOARD OF FLORIDA

October 1, 1919

STATE PLANT BOARD

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J. G. KELLUM	*Auditor*
MISS MARGUERITE HITCH	*Stenographer*

PLANT COMMISSIONER'S OFFICE

WILMON NEWELL	*Plant Commissioner*
J. C. GOODWIN	*Chief Clerk*
MISS ETHEL MURRILL	*Stenographer*
MISS ELITA LOVEJOY	*Stenographer*
MISS EVA C. MEANS	*Filing Clerk*
HENRY LLOYD (Col.)	*Janitor*

BEE DISEASE ERADICATION

C. E. BARTHOLOMEW	*Assistant to Plant Commissioner*
C. F. GLENN	*District Apiary Inspector*

COTTON BOLL WEEVIL INVESTIGATION

E. K. BYNUM	*Inspector*

CANE DISEASE SURVEY

D. N. REYNOLDS	*District Inspector*
J. L. LAZONBY	*Inspector*

DEPARTMENT OF ENTOMOLOGY

E. W. BERGER	*Entomologist*
G. B. MERRILL	*Assistant Entomologist*
MRS. G. E. MCLENDON	*Stenographer*

QUARANTINE DEPARTMENT

J. H. MONTGOMERY	*Quarantine Inspector*
A. C. BROWN	*Assistant Quarantine Inspector*
U. C. ZELUFF	*Assistant Quarantine Inspector*
E. M. GRAHAM	*Assistant Quarantine Inspector*
R. A. KNIGHT	*Assistant Quarantine Inspector*
R. D. POTTER	*Assistant Quarantine Inspector*
HAROLD MOWRY	*Assistant Quarantine Inspector*
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Vol. IV January, 1920 No. 2

THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by
STATE PLANT BOARD OF FLORIDA
GAINESVILLE, FLA.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. IV APRIL, 1920 No. 3

THE SOUTHERN GREEN STINK-BUG* IN FLORIDA

CARL J. DRAKE†

A large green plant-bug, *Nezara viridula* Linn., has long been known as a serious plant and fruit pest in Florida. In 1885 Hubbard‡ (notes and excerpts from correspondence) calls attention to the sudden rise of this insect into economic importance and briefly discusses its depredations upon a number of garden vegetables, truck plants and field crops in addition to the orange trees. During the last decade the insect has been greatly increasing in numbers and its ravages have been especially great, not only in Florida, but in other states bordering on the Gulf of Mexico.

The observations and investigations herein recorded were carried on chiefly at the University of Florida Experiment Station, Gainesville, Florida, during the summer of 1918. All original illustrations, except figures 7, 17, 33, 37 and 39, have been made by the author. Mr. W. C. Wessel has kindly made the drawings for figures 7, 17 and 33. I am indebted to Prof. J. R. Watson for securing the photograph for figure 39, and to Prof. J. B. Thompson for kindly loaning the negative for figure 37. Several illustrations have been secured from the United States Department of Agriculture, the Ohio Agricultural Experiment Station and the Agricultural Experiment Station of the University of Florida; these are duly credited when used herein. At this opportunity the author wishes to express appreciation to Prof. J. R. Watson and to Dr. E. W. Berger for kindly turning over the correspondence and records of the Experiment Station and Florida State Plant Board, respectively, relating to the project and for much valuable criticism and advice. Thanks are also due Mr. Wilmon Newell, Plant Commissioner, for going over the manuscript and suggesting changes. The food plants have been determined largely by Professors Thompson and Watson. Through the co-operation of the County Agents, University of

**Nezara viridula* Linn.

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‡See footnote, page 52.

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Florida Agricultural Extension Division and the Florida State Plant Board staff many living specimens were secured from various parts of the State. A number of farmers and citrus growers have also kindly sent in specimens for breeding purposes.

Historical

This plant-bug was first described by Linnaeus in 1758 (p.444) under the scientific name *Cimex viridulus* from specimens collected in India. Since then, according to Van Duzee‡ (1917b, p. 58), the insect has been redescribed under numerous other scientific names by various authors. The species is now placed in the genus *Nezara* of Amyot and Serville. Three good color varieties are recognized; namely, *smaragdula* (Fabricius), *torquata* (Fabricius) and *hepatica* Horvath. These color varieties are not known to occur within our limits.

Nezara viridula, like many of our most destructive insect pests, is of foreign origin and was undoubtedly imported to the West Indies and North America many years ago. Owing to the paucity of data it is impossible to conjecture how, when, or even where the insect was introduced into Florida.

Classification and Common Name

Nezara viridula (Linn.) belongs to the group of insects commonly called the "true bugs" or the suborder Heteroptera of the order Hemiptera. It is placed in the "stink-bug" family called Pentatomidae. The pentatomids are widely known as "stink-bugs" because they emit a very malodorous and ill-tasting substance for protective purposes. This insect is known by a number of common or popular names as the "green-bug," "tomato and bean-bug," "southern green plant-bug," "pumpkin-bug," "green soldier-bug," "green-bug of India," etc. On account of its distribution in the United States (southern part), color (light green), and widely known family name (stink-bug), I have used the name "southern green stink-bug" as a common name for it.

The Adult

The adult (typical form) southern green stink-bug (Fig. 6) is a large light green shield-shaped bug. Over-wintering specimens and pinned specimens in collections are sometimes slightly faded, the light green being more or less replaced by a brownish or purplish hue. The average sized individual is about ½-inch

‡The numbers (years and pages) in parenthesis refer to bibliography, the papers being arranged chronologically for each author. The authors are arranged alphabetically.

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long and about 1/3-inch in width. Both male and female are slightly variable in size, the female usually being a little larger than the male. The antennae or feelers are each composed of four segments. The legs and wings are well developed. The beak or rostrum is four-jointed.

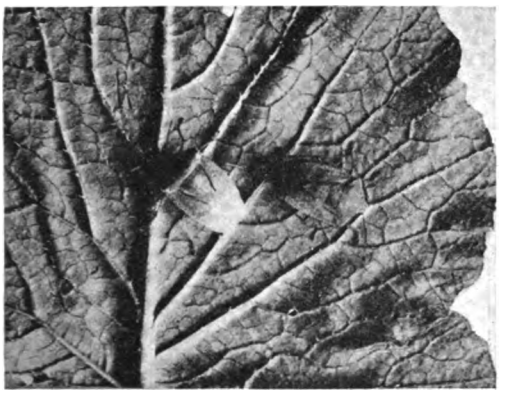

Fig. 6.—Adults of the southern green stink-bug (*Nezara viridula*), natural size. (After Watson, Bull. 148, Fla. Agr. Exp. Stat.)

The variety *torquata* (Fabricius) differs from the typical form in having the head, except for a distal green spot, anterior portion of thorax, three small spots at the base of the scutellum, and the connexivum yellow. The variety *smaragdula* (Fabricius) is of the usual green color, but can be readily distinguished from *torquata* by having only three rather large yellow spots at the base of the scutellum. The variety *hepatica* (Horvath) is somewhat similar to the variety *torquata*, but the green color above is replaced largely by sordid brown. The anterior portion of the head and thorax, the basal portion of the scutellum and a mark on the wing are stramineous.

Closely Allied Species

Four closely related species of pentatomids, *viridula* Linn., *hilaris* Say, *pennsylvanica* DeG. and *marginata* P. B., occurring in the United States, usually have been placed in the genus *Nezara* of Amyot and Serville, the genus *Acrosternum* of Fieber being considered a synonym of *Nezara*. Dr. Bergroth (1914, p. 25), on the structure of the osteolar canal (Fig. 10, o= osteolar canal) and on the structure of the male genitalia as noted by Sharp (1890, pp. 406-408), pointed out the generic differences between the two genera and raised the genus *Acrosternum* to a valid genus. This leaves only *viridula* Linn. in the genus *Nezara*, the other three species falling in the genus *Acrosternum*. All four of these insects occur in Florida.

Acrosternum marginatum P. B. is a rather rare insect and seems to be a tropical species. It has been reported from southern Florida. Nothing is known of its life history or habits.

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Acrosternum pennsylvanicum DeG. is a widely distributed species in the United States. During the summer three specimens were sent to the Florida State Plant Board from Fort Myers. These specimens were taken with a long series of *Nezara viridula* on orange trees and on garden and truck plants. The writer collected one specimen on a small scrub oak near Gainesville on July 4. Lugger reports the species on grape in Minnesota. No report has been made on its life history or habits.

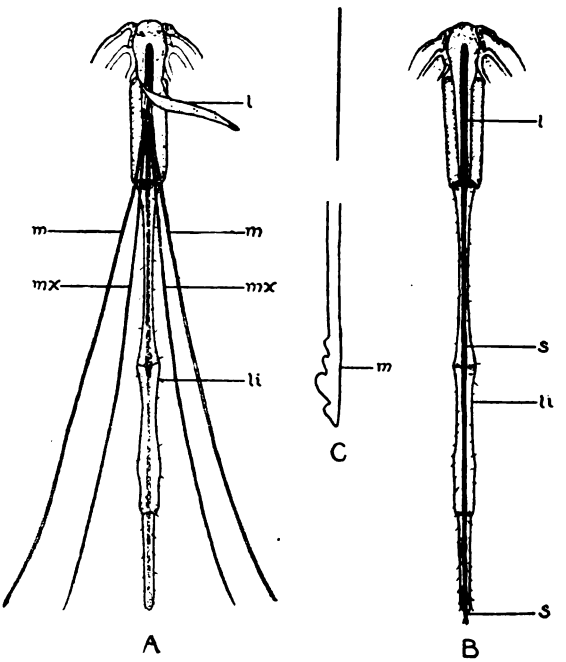

Fig. 7.—Mouthparts of the southern green stink-bug (*Nezara viridula*) :A, dorsal aspect with setae separated; B, dorsal aspect showing setae in normal position within sheath; *l*, labrum; *li*, labium; C, tip of mandible greatly enlarged; *m*, mandible; *mx*, maxilla; *s*, setae within sheath (labium); *s'*, tips of setae. Enlarged. (Original, from drawing by Wessel.)

Acrosternum hilaris Say is commonly known as the northern green soldier bug. In fact *N. viridula* has often been confused in literature in the South under this name. The northern green soldier bug is a transcontinental form that occurs over the greater portion of the United States, becoming more abundant in the northern states. It is distinctly a shrub-inhabiting species, only occasionally being found on herbaceous plants. In this respect its habits are quite distinct from those of the southern green stink-bug *Nezara viridula,* which is primarily an herb-inhabiting form. These two species resemble each other very closely in color, form and size, but they can be readily separated by the shape of the osteolar canal (Fig. 10; o=osteolar canal).

The habits and life history of the northern green soldier-bug have been published by Whitmarsh (1917). In Ohio it occasionally does a considerable amount of damage to peaches. The food plants listed in literature are box elder, dogwoods (*Cornus*

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florida and *C. alternifolia*) wild cherry (*Prunus serotina*), black-haw, common elderberry, catalpa, apple, peaches, oranges, corn, okra, golden rod, egg-plant, cabbage, beans, cotton and seed pods of mesquite (growing near cotton fields in Texas). Less than two dozen specimens of this insect were seen by the author during the entire summer in Florida. In the vicinity of Gainesville the author took it upon *Crataegus* sp. (adults and one egg cluster after incubation), rattle-box (*Crotalaria*), mulberry, wild plum, hop hornbean or ironwood, castor bean and blackberry. The specimen on *Crotalaria*, collected August 10, bore eggs of a tachinid parasite, *Trichopoda pennipes*, the parasite being reared in the insectary. Many specimens of pentatomids and other plant feeding insects were received at the Experiment Station and State Plant Board from various parts of the state during the summer but *A. hilaris* was represented by only four specimens. Several species of brown stink-bugs, belonging to the genus *Euschistus*, also feed upon citrus trees and cultivated plants. The brown color will readily enable one to distinguish them from either *Nezara* or *Acrosternum*.

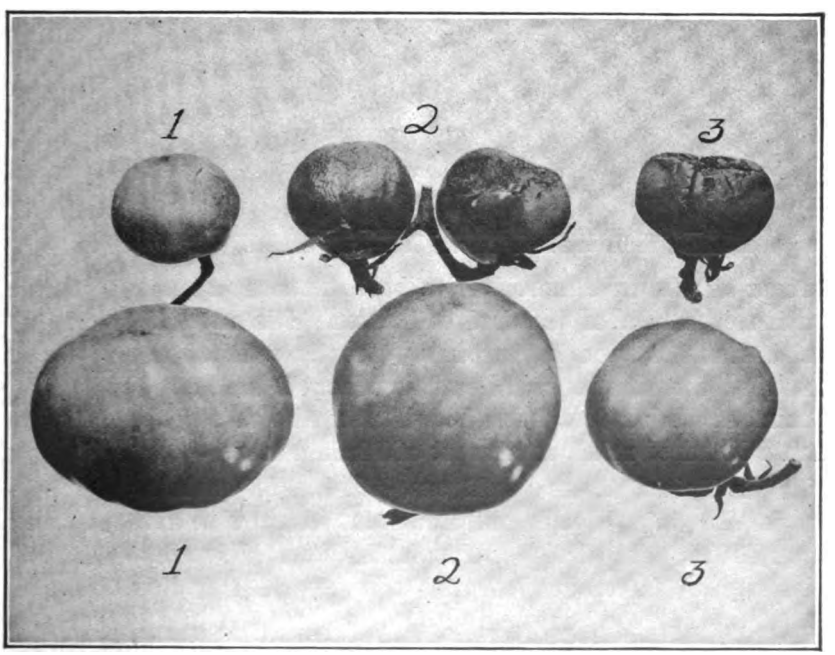

Fig. 8.—Injury to tomato fruit by nymphs of the southern green stink-bug (*Nezara viridula*): Injured fruit above, normal fruit below. Developing fruit was covered with cheesecloth sacks in which nymphs were confined. Fruit bearing same numbers were approximately the same size when enclosed in sacks.

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DISTRIBUTION

The southern green stink-bug is one of the most universal and widely distributed species of plant feeding insects. In fact it is found throughout the tropical and neotropical regions of almost the entire world. Lethierry and Severin (1893, p. 167) give its distribution as Europe, Asia, Africa, and America. Numerous records have been published for the West Indian Islands, northern

Fig. 9.—Puncture marks on radish pods caused by the feeding of both nymphs and adults (*Nezara viridula*). Slightly enlarged. (Original, photo by author.)

portion of South America, Central America, Mexico and the southern portion of the United States. Distant (1880, p. 79) states that the wind has probably greatly assisted the insect in its wide dissemination; while sailing from India he found several specimens which had been blown aboard the ship when more than a hundred miles southwest of Madagascar.

In the United States VanDuzee (1917, p. 58) catalogs the species for Virginia, Florida and Louisina. In addition to these states Jones (1918, p. 11) lists California, Arizona, New Mexico, Texas, Mississippi, Alabama, Georgia, and South Carolina. Bueno (1912, p. 316) records the finding of a specimen in a greenhouse in Brooklyn, New York, and states that it was probably brought in on plants from Florida or introduced from Europe. Prof. J. G. Sanders kindly sent the writer two specimens which were col-

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lected at Hummelstown, Pennsylvania, by Mr. J. N. Knull. The numerous published records and the many letters in the files of the Florida Experiment Station and the Florida State Plant Board show that the insect is common over the entire state of Florida, often becoming a serious pest in many places.

Food Plants†

In nature the southern green stink-bug feeds upon many different kinds of plants. It is distinctly an herb-inhabiting and herb-feeding species; only occasionally are shrubs and trees infested. All parts of a plant are attacked, but it is particularly at home on the fruit and on the tender growing shoots. This applies to the nymphs (the young) as well as to the adults.

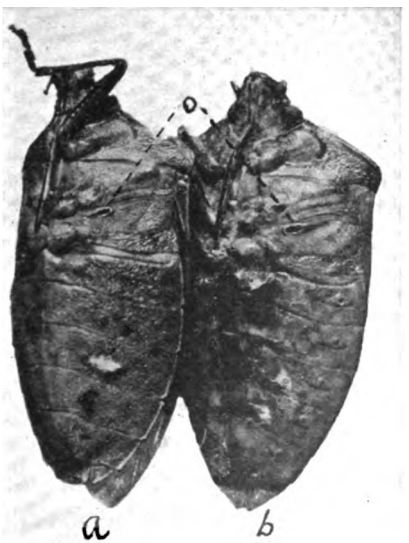

Fig. 10.—Ventral view showing (o) osteolar canal: a, *Nezara viridula*; b, *Acrosternum hilaris*. Enlarged, photo by author.

Various authors have cited the insect as feeding on radish*, mustard*, turnip, collard*, cauliflower, cabbage, okra*, beggarweed*, peas*, cowpeas*, peanut*, beans*, tomato*, potato, tobacco, Brussels sprouts, sweet potato, cotton*, pepper, *Gynandropsis pentaphylla*, eggplant, sunflower, sugar cane, corn or maize, rice, pecan, lime, peaches, grapefruit, orange*, lemon, hackberry and mulberry. In addition to a number of the above plants the writer has found the insect feeding on rattle-box* (*Crotalaria usaramoensis*), everlasting pea* (Lathyrus sp.), butterfly pea* (*Clitoria* sp.), Mexican clover* (*Richardsonia scabra*), sorrel* (*Rumex* sp.), wild blackberry, wild grape (*Vitus* sp.), castor bean*, passion flower or maypops* (*Passiflora incarinata*), wild plum (*Prunus* sp.), an introduced cereal plant* (*Amaranthus leucocarpa*), spiny amaranth* (*Amaranthus spinosus*), *Amaranthus* spp.* (two wild

†In addition to the plant feeding habit Hubbard (1885, p. 159) reports that the insect is, to a certain extent, predaceous. Prof. J. R. Watson can state irrefutably that the insect will sometimes bite man. The writer has failed to observe or to make the insect feed upon other insects and in handling several hundred speciments has never been bitten.

*See footnote p. 48.

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species), nut grass* (*Cyperus esculentus*), lamb's quarters*, (*Chenopodium acuminatum*), chayote*, cucumber*, pepo or crook-neck squash*, Japanese pumpkin*, sandbur or bur grass* (*Cenchrus sp.*). In late fall specimens have been taken on pokeweed by Dr. Berger, and on dwarf Essex rape by Prof. Watson. The insect feeds upon all varieties of cowpeas, peas and beans, but not enough data have been collected to determine the varieties less susceptible to attack.

The long list of food plants shows that the insect is a very general feeder and that it can subsist upon a great variety of plants. However, it probably does not breed, at least in great numbers, on all these plants and only occasionally feeds on a number of them. Observations show that the insect has a very decided preference for a few plants. This preference, of course, varies with the development of the preferred food plants and in different seasons of the year. Watson (1918, p. 231), states "It breeds particularly on such legumes as cowpeas and beggar-weed and when these plants are grown as a summer crop in the (citrus) groves and allowed to stand too long, the bugs attack the citrus fruit." Jones (1918, p. 14) states "In the late fall and early winter the various stages are often abundant on mustard and turnip." The author found radish and collard (both growing in the same row) to be greatly preferred by the bugs in spring and early summer; in fact so alluring that tomatoes and other garden and truck crops growing in the same patch or even in adjoining rows were scarcely infested at all. Rattle-box, an introduced forage plant on the Station grounds, proved to be one of the most attractive plants to the insects during July, August and September; this plant served a double purpose as the parasites were greatly attracted by its flowers. The marked preference for preferred food plants, such as radish, cowpeas, rattle-box and begger-weed, is greatest by far during the period of fruit formation. After the fruit is mature and lignification has set in, the bugs wander to more succulent plants. This was nicely illustrated during

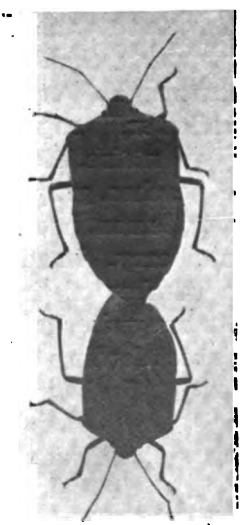

Fig. 11—Male and female of the southern green stink-bug (*Nezara viridula*) in the act of mating. Slightly enlarged. (Original, photo by author.)

*Eggs or young nymphs were found on this plant at Gainesville during the summer of 1918 by the author.

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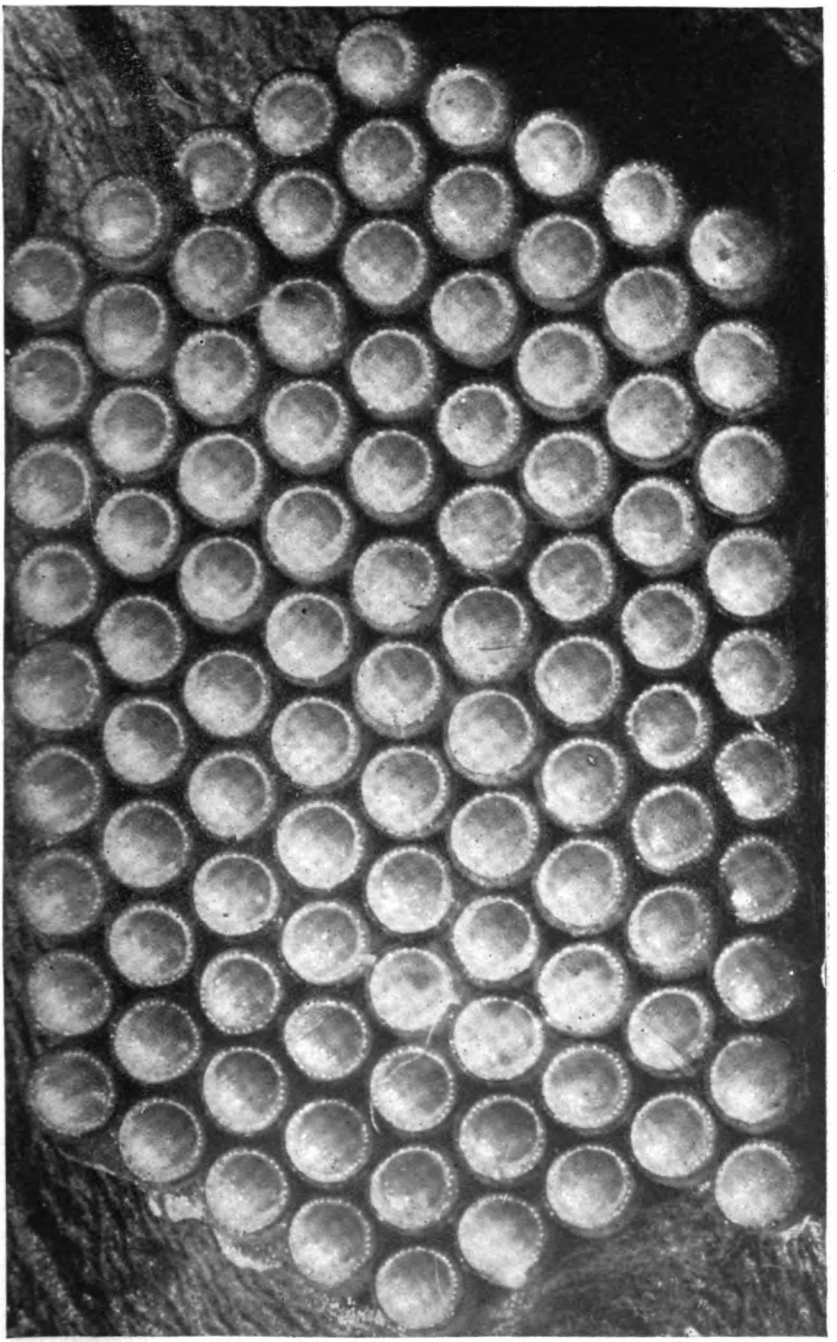

Fig. 12.—Egg cluster of the southern green stink-bug (*Nezara viridula*) before hatching. Greatly enlarged. (Original, photo by author).

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the summer on some plots of cowpeas that matured on slightly different dates. The difference of time of maturing was due to different varieties of plants or that the same variety had been planted on different dates. Young plants were not at all or only slightly infested while fruiting plants were usually very severely infested. On the other hand, mature plants, as a rule, were only

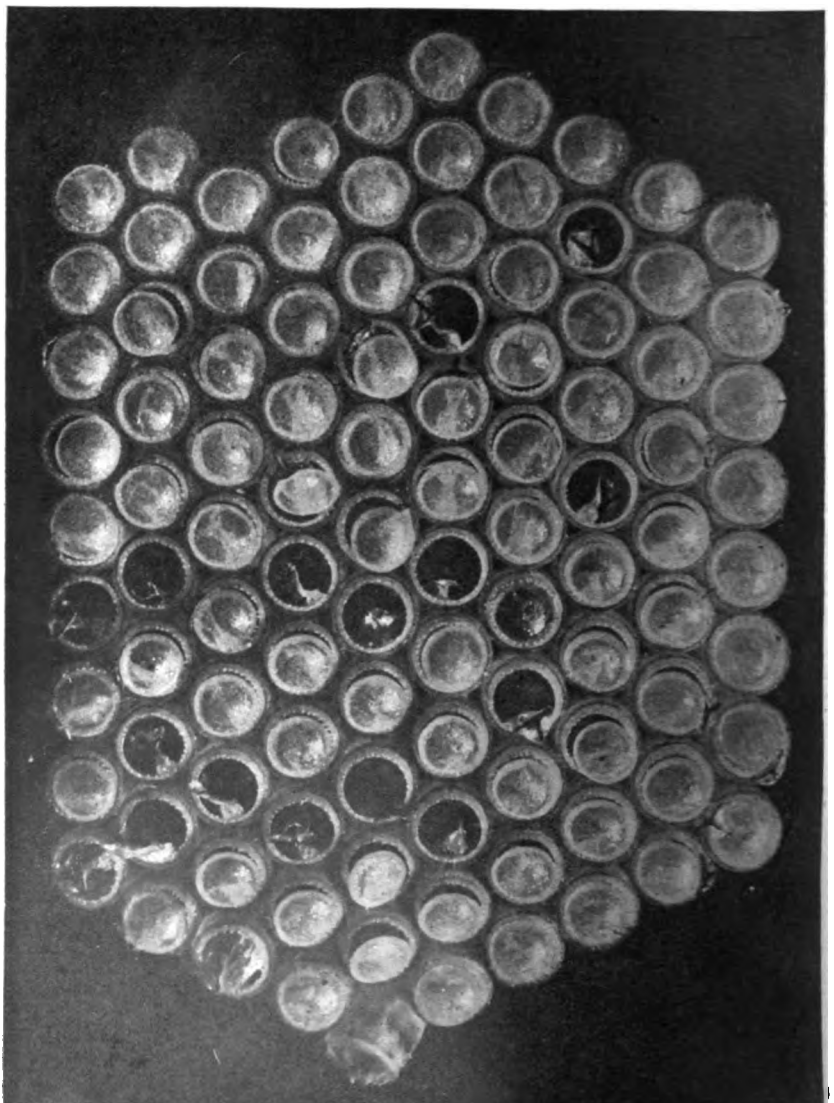

Fig. 13.—Egg cluster of the southern green stink-bug (*Nezara viridula*) after hatching. Greatly enlarged. (Photo by author.)

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slightly infested because the bugs, as they matured, migrated to other food plants. No food plants, the preferred ones included, are desirable for the bugs after the fruit has matured or lignification has set in.

Method of Securing Food

The mouthparts of the southern green stink-bug (as in all Hemiptera) are modified to form a structure for piercing and sucking. This structure (Fig. 7) is known as the beak or rostrum and when not in use it is carried flat close to the ventral portion of the body between the legs (Fig. 10). This beak or rostrum is an elongated, four-jointed, tube-like structure, containing four long, lance-like setae (Fig. 7; B). The thicker and heavier pair of setae are called the mandibles (Fig. 7; B. m) and the thinner pair the maxillae (Fig. 7; B. mx). These four setae, the mandibles and maxillae, are sharp-pointed structures which pierce and enter the plant when the bug feeds. It is capable of taking only liquid food.

Nature of Injury and Economic Importance

Both nymphs and adults obtain their food by puncturing the tissues of plants with their beaks and then extracting the plant juices. They attack all parts of a plant, as stem, foliage, flower and fruit, but greatly prefer the young tender growth and fruit. The numerous feeding punctures, caused by the insertion of the rostrum, make minute, hard, brownish or blackish spots on the plant. These spots are not only unsightly, but sometimes they are the avenue for infections and decay.

On mature fruit, the feeding punctures seriously mar its ap-

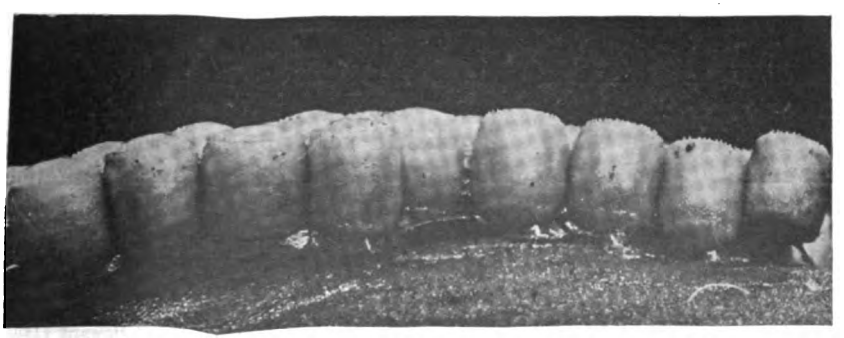

Fig. 14.—Later view of the eggs of the southern green stink-bug (*Nezara viridula*) on radish pod. Greatly enlarged. (Photo by author.)

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pearance, greatly affect its edible qualities, and decidedly lower its market value. Such fruit is consigned to an inferior grade, or in the case of severe infestation it becomes worthless and must be discarded. Attacked, young immature fruit is much retarded in growth and greatly distorted, or hard callouses form around the punctures. Sometimes it even drops from the plant before or after maturity. Young plants and young growing shoots are greatly retarded by their attacks and, occasionally, they are even entirely destroyed or fail to bear fruit. Such injury has been noted on a number of cultivated plants in gardens

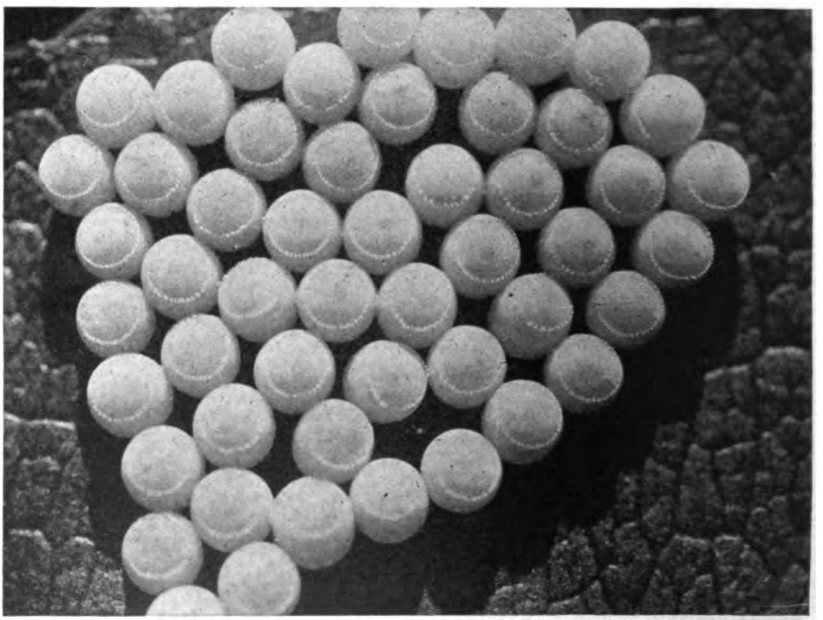

Fig. 15.—Egg cluster of the northern green soldier-bug (*Acrosternum hilaris*). Greatly enlarged. (After Whitmarsh, Bull. 310, Ohio Agr. Exp. Stat.)

and fields, also on young orange trees and on the tender growth of older trees.

To quote from the first published account of the ravages of this insect by Hubbard* (1885, pp. 159-161; from correspondence of James Franklin, West Apopka, Fla., Jan. 31, 1883):

"They mature very quickly, and increase with surprising rapidity, continuing to breed until November. In the spring and early summer they

*Hubbard gives this account under "The Green Soldier Bug" or *Raphigaster hilaris* Fitch, but he undoubtedly refers to *Nezara viridula* Linn. as *hilaris* Say (the northern green soldier-bug) has never been known to occur in great numbers in Florida. Riley and Howard (1893, p. 264) state "* * * the species which he (Hubbard) figures upon page 160 is in all probability the same as your number 2 (*Nezara viridula*) * *."

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confine their attacks principally to garden vegetables and succulent weeds. They are particularly abundant on tomato vines, egg-plants, turnip tops, and mustard, seldom doing much damage to the orange trees at this season. When pea-vines are well grown, about or a little before the time of blossoming, they abandon nearly everything for the pea-vines. Last year they totally destroyed my garden. Not one tomato came to perfection. Where the insect had inserted its sucking-tube a reddish yellow spot appeared. When cut the fruit was full of lumps and totally devoid of flavor. The tomato vines grew so enormous a crop that the ground was almost covered by the fallen fruit. Last year I had 35 acres planted in cow-pea vines, which bore an enormous crop of peas; but not enough sound peas could be gathered to plant 5 acres of additional land. Later it was impossible to find a sound pea. I attempted to turn under the vines, but so luxuriant was the growth that it could not be done. Towards the end of August the pea-vines were dead or dying, when the bugs swarmed to the orange trees, killing nearly all the new growth. Immense numbers were killed by keeping men constantly going over the grove, shaking the trees, and killing all that fell on the ground. The wingless individuals were readily killed, but a large number of mature insects saved themselves by flight. * * * The number of insects is incredible. When thoroughly shaken, the ground under the trees would be alive with fallen insects, and two days later just as many would be found."

Watson (1918 a, p. 59R) gives the following report of the insects on citrus:

"Many complaints of damage done to citrus by plant-bugs were received in October and November. Plant-bugs attack the young shoots of the trees causing them to wilt and die. In young groves they often do considerable damage in this way during the summer. On large trees the damage is negligible. It is the fruit that sustains the most severe damage. This turns yellow around the punctures which, if sufficiently numerous, cause the fruit to fall. These fruits are dry and tasteless, the juices having been withdrawn by the bugs. Tangerines are most severely attacked; oranges are the second choice, while grapefruit is not much troubled."

Many complaints were received during the past year (1918). A letter from Mr. F. D. Waite of Palmetto, Florida, states:

"We estimate that we threw away one thousand crates of tomatoes which were bug-sucked and 500 crates put in seconds that were damaged to some extent by the same bug. The damages or loss, at prices received during the past season, would amount to at least $4,000 on 14 acres of staked tomatoes. As they were staked we were able to gather the bugs

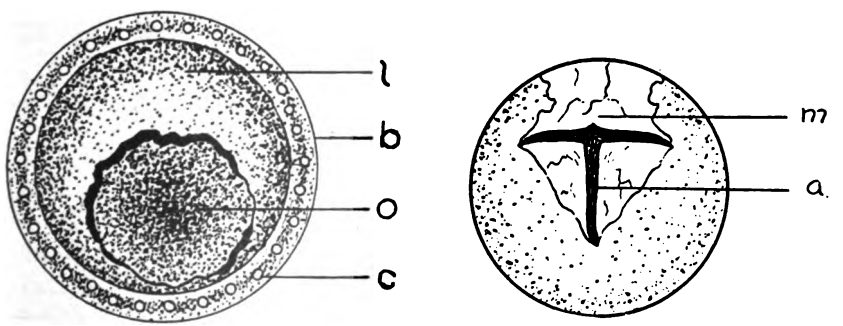

Fig. 16.—Dorsal aspect of the eggs of the southern green stink-bug (*Nezara viridula*): *l*, disc-shaped lid or cap; *b*, outer wall or barrel of eggshell; *c*, chorial process; *o*, hole in lid made by egg-parasite in escaping from the egg; *a*, T-shaped egg-burster; *m*, membrane. Enlarged. (From drawing by Wessel.)

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by hand and employed women and children almost constantly for two months. The bugs at first were noticed working on what we call cockspur weed around the margins of the tomato fields."

"The bugs have been increasing every season and we find them all over our 500 acres of groves, but only twice have they done much damage to the oranges."

Dwarf Essex rape is a very desirable food plant during late fall and winter. Prof. Watson states:

"There are thousands of the bugs on this plant in the fields during December. In fact it seems to be one of the most attractive plants just now. There is a distinct tendency to collect in colonies, a tendency not observed in summer time. Under some leaves I found as many as a dozen adults in a group. I could easily see where the bugs were when the bugs themselves were out of sight. Even one bug on a leaf seems to be capable of wilting it. Only a very few specimens bore tachinid* eggs on their bodies. I noted an adult tachinid fly the other day, but they are quite scarce now."

Dr. W. E. Hinds states that *Nezara viridula* has done extensive damage in southeastern Alabama, particularly in the fall of 1916. He believes that the insect is spreading and increasing in injuriousness in Alabama (from Station correspondence).

In Georgia, Turner (1918, p. 491) reports the insect as a serious enemy upon pecans, and that there was a severe infestation during 1916. In the groves, cowpeas are commonly grown as a soiling crop during the summer, the vines being turned under late in the fall. In September or early October, after the cowpeas have matured and the vines begin to dry up, the bugs leave the cowpeas and migrate to the pecan trees. In some cases the

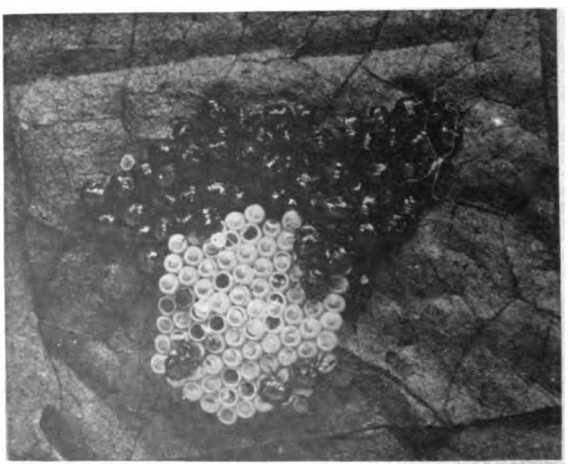

Fig. 17.—Nymphs of the southern green stink-bug (*Nezara viridula*) showing gregarious habit during first instar. Enlarged. (Photo by author.)

*See family Tachinidae, p. 67.

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bugs have been observed feeding upon the nuts. Experiments are being conducted by Turner to determine the relationship between the feeding punctures of the bug and the kernel spot of pecan. So far the data obtained strongly indicate that *Nezara viridula* is an important agent in either the actual production or the dissemination of the disease. Similar experiments with *Nezara viridula* and other plant feeding bugs, are being conducted by Nowell (1918, p. 217), in the West Indies, on the internal diseases of the cotton boll.

In India, Atkinson (1889, p. 4) calls the insect the "green bug of India" and states that it did considerable damage, in 1889, to the potato halms. According to Froggatt (1916, p. 649) the species has been recently introduced into Australia and the number of individuals has been increasing very rapidly. In the neighborhood of Sidney it is a pest upon potatoes, tomatoes and French beans. It is commonly called the "tomato and bean-bug" in Australia.

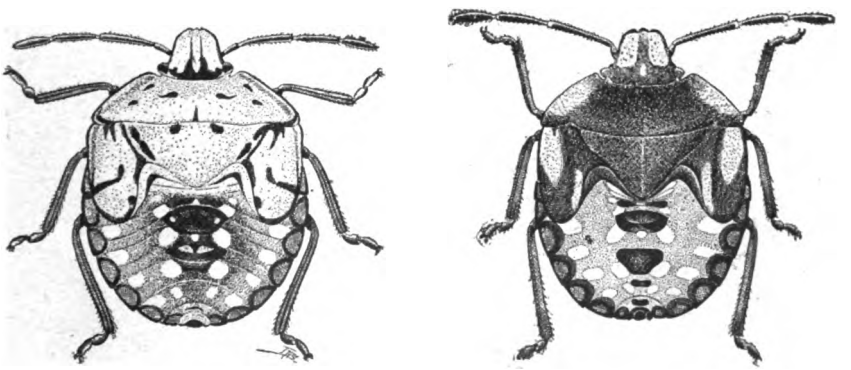

Fig. 18.—Light and dark colored forms of the southern green stink-bug (*Nezara viridula*); fifth instar, enlarged about 4 diameters. (After Jones, Bull. 689, U. S. D. A.)

Habits and Life History

Hibernation

In Florida, as well as in the other states bordering on the Gulf of Mexico, the hibernation of the southern green stink-bug is only partial, a few of the adults remaining upon succulent plants throughout the entire winter. Watson (1918 b, p. 232) states: "They are abundant in October, plentiful in November, common in December but rather scarce in January and February." In the southern portion of the state the bugs are more abundant and active during the winter months. Many stragglers

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or belated nymphs of the last brood are found in the fields during late fall and early winter. These, at least the most of them, are able to mature and to seek favorable hibernating quarters during the warmest hours of the day. However, there are no winter broods in the State and only adults are found throughout this season of the year.

The hibernating forms secrete themselves beneath the loose bark of trees and logs, among and beneath fallen leaves, in

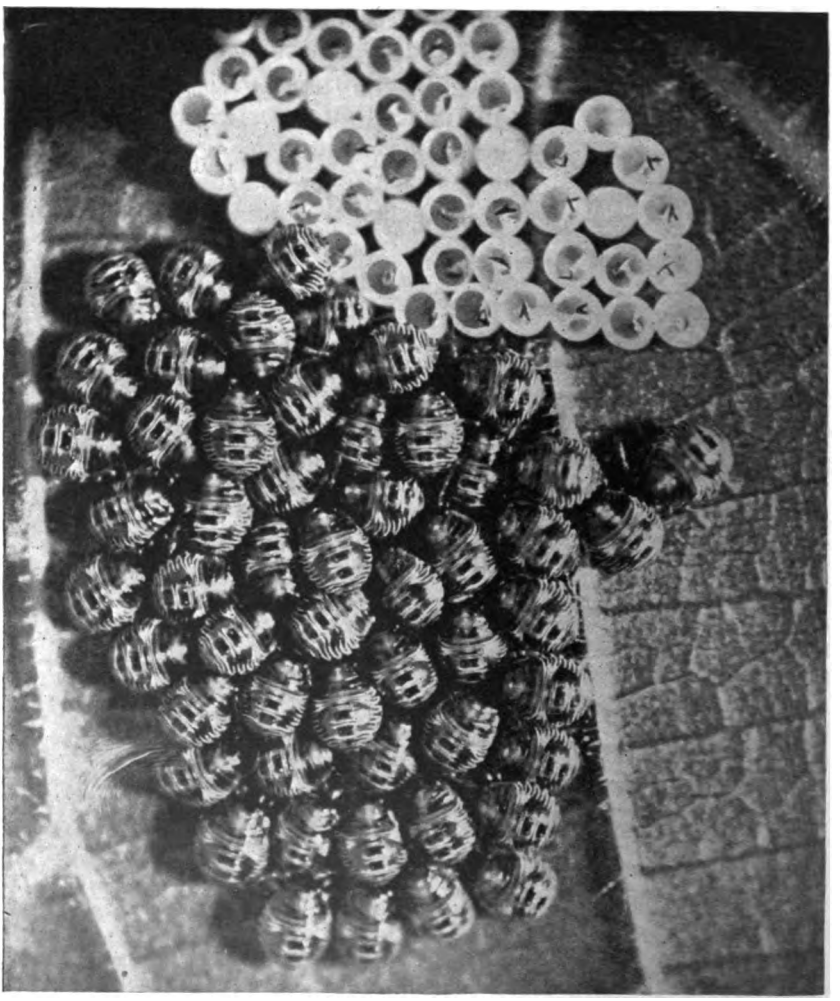

Fig. 19.—Cluster of nymphs of the northern green soldier-bug (*Acrosternum hilaris*) showing gregarious habit during first instar. Greatly enlarged. (From Whitmarsh, Ohio Agr. Exp. Stat. Bull. 310.)

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Spanish moss, under boards and sticks and in almost any secluded place that offers a slight protection from the weather. In Louisiana, Rosenfeld (1911, pp. 401, 403, 404 and 405) enumerates the species among the insects and spiders found hibernating in Spanish moss during the months of December and January. Dozier found several specimens beneath the bark of dead "live oak" on the campus of the University of Florida. Prof. Watson states that hammocks afford the most favorable retreats for the bugs in Florida and that the food plants, either wild or cultivated growing close to hammocks are the first to become badly infested in early spring. The individuals that overwinter on food plants afield are quiet and somewhat sluggish or even torpid on cold days, but rather active and often feed during the warmest hours of warm days during mild weather.

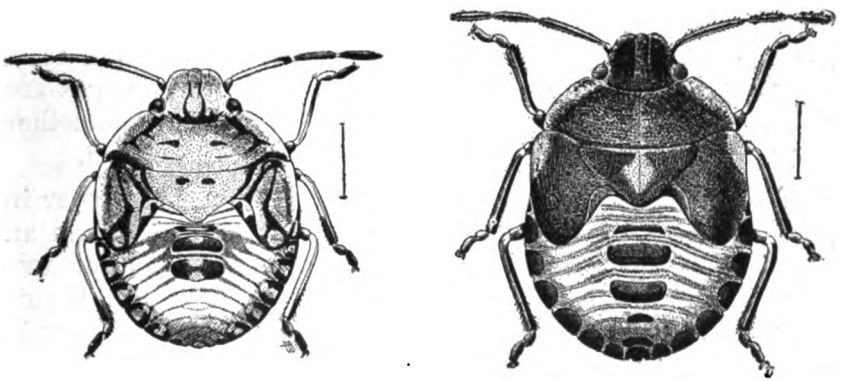

Fig. 20.—Light and dark colored nymphs of the northern green soldier-bug (*Acrosternum hilaris*); fifth instar. Enlarged about 4 diameters. (After Jones, Bull. 689, U. S. D. A.)

Copulation

On the approach of warm days in early spring the hibernating forms wander from their secluded winter haunts in search of food. Mating begins almost immediately. This is about the middle of March or a little later in the vicinity of Gainesville and somewhat earlier in the southern part of the State. During copulation the male and female (Fig. 11) face in an opposite direction with the caudal extremities of their body together. They are somewhat sluggish at this time and are not readily disconcerted. If molested, they fall to the ground, usually not becoming detached from each other. No pairs have been observed in flight while mating, but feeding continues normally. The process has been timed and found to vary considerably in different

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pairs. It is not uncommon for a pair to remain constantly *in coitu* for a day or even longer. Under natural conditions copulation is repeated a number of times until the eggs have been deposited.

Both field and laboratory observations show that the males are polygamous and the females polyandric. After feeding a few days newly emerged adults reach sexual maturity. This period was found to vary from about three to five weeks or in some cases even longer.

Oviposition

At Gainesville, the overwintering adults begin to deposit eggs about the middle of April. The eggs are usually placed in very regular clusters (Figs. 13 and 14) upon the surface of the host plants, preferably on the underside of the leaf, where the insects are feeding or resting. At the time of deposition the eggs are covered with a viscid liquid which glues the eggs to one another and to the surface of the plant upon which they are laid.

The process of egg-laying has been observed by the writer in the laboratory. The first eggs are deposited so as to form an inverted V-shaped row (Fig. 12, top of page). This forms two of the narrower sides of the cluster. After depositing this row the female remains in the angle of the V. Just as she is ready to lay another egg, she puts her ovipositors against the egg at one end of this row, then tilts her body slightly forward and drops an egg. As the egg leaves her body it is guided by the ovipositors and placed on end with the cap or disc-shaped lid up against the other eggs. The ovipositors are immediately placed against the sides of the freshly laid egg, probably to straighten it slightly and to hold it in its normal position for an instant while the glue hardens. In a like manner another egg is laid, and thus the process continues until the entire egg cluster has been deposited. One, two or even three rows may be in the process of formation at a time. Only a few seconds are consumed in dropping and placing an egg in its normal position, but the interval between the laying of two consecutive eggs varies in different females from one to four minutes. Ordinarily, the average sized egg cluster is deposited in about an hour and a half to two or three hours.

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The Eggs

The Egg Cluster.—The eggs are generally laid in regularly shaped, compact, hexagonal clusters in which the individual eggs are arranged in very regular rows and firmly glued together. Figures 12 and 13 illustrate the two most common forms of egg

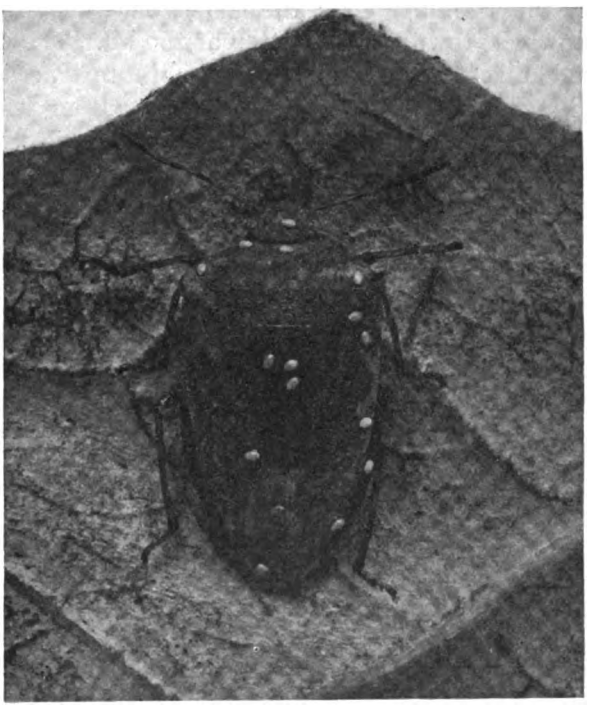

Fig. 21.—Adult of southern green stink-bug (*Nezara viridula*) bearing eggs of a tachinid parasite (*Trichopoda pennipes*). Enlarged. (Photo by author).

clusters found in the field. At the time of deposition the eggs are light yellowish white or cream in color.

During the summer of 1918 many egg clusters, which had been deposited by insects not in confinement, were collected on various food plants in the fields. These egg clusters, with one exception, were composed of from 61 to 126 eggs. A small cluster found on a radish pod during the third week in May contained only 46 eggs. In Louisiana, Jones (1918, p. 15) states: "Egg clusters deposited outside of confinement and examined by the writer have, with one exception, been made up of from 60 to

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116 eggs. A cluster taken on November 3 contained only 36 eggs."

The Egg.—The egg (lateral view, Fig. 15) is light yellowish-white in color, somewhat cup-shaped, flat on top, the top being closed with a disc-shaped cap or lid. On the top quite regularly arranged in a circle around the disc-shaped cap or lid are about 30 delicate, club-shaped, chorial processes. These processes are attached by their smaller ends, the larger ends usually pointing obliquely upwards towards the center of the lid. The outer surface of the chorion, or egg-shell, shows minute traces of hexagonal markings. The egg is a little longer than wide, being about 1/20 of an inch in length and 1/29 of an inch in width.

According to Whitmarsh (1917, p. 523) the egg of the green soldier bug, *Acrosternum hilaris* (Fig. 15) has about 65 chorial processes on top of the egg. The author agrees with Jones (1918, p. 5) in finding the number of chorial processes on top of the egg of the southern green stink-bug, *Nezara viridula* (Figs. 13 and 14) to range from 28 to 32. The number of chorial processes will readily enable one to discriminate between the eggs of the two species.

Fecundity of the Females

Numerous adults, reared from eggs deposited in the insectary or from both eggs and nymphs collected in the field, were placed in breeding cages and kept until their death. These reared adults, a male and female being placed in each cage, were confined in ordinary glass tumblers or glass stender dishes until their death. Green tomatoes, radish pods, and cowpea pods were used almost exclusively for food.

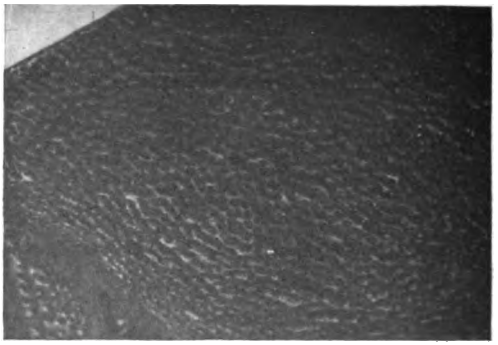

Fig. 22.—Hole through body of host (*Nezara viridula*) made by young maggot of tachinid fly (*Trichopoda pennipes*), egg-shell removed. The young tachinid maggot escapes from the egg by making a hole through the attached or flat side of the egg-shell and body wall of host. Greatly enlarged. (Photo by author.)

The number of eggs and the number of clusters of eggs deposited by different females are somewhat variable. The majority of the females only laid one cluster of

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eggs, but several laid two clusters and a few laid even three. On the other hand, a few females never deposited any eggs at all. In some cases eggs were found at death in the ovaries of females that had deposited no eggs or that had deposited one, two or even three clusters of eggs; in other cases no eggs were found. One of the females, which had deposited three clusters of eggs (78, 70 and 64 eggs respectively), laid a total of 212 eggs. No eggs were found in her ovaries at death. In Louisiana, Jones (1918, pp. 16 and 17) states that a female deposited a total of 240 eggs (3 clusters of 87, 83 and 70 eggs respectively) and that 77 eggs were found in her ovaries at death. Most of the females deposited an egg cluster in about three to five weeks after becoming an adult.

Incubation

Early in the incubation period the eggs begin to turn pinkish and a red crescent spot appears on the lid or cap. These colors gradually grow deeper and more conspicuous until hatching. After hatching the chorion, or egg-shell, is whitish. The average time for incubation during the summer is about six days. A few clusters have hatched in four days, but during early spring and late fall the period of incubation is often greatly extended, the time varying from about two to three weeks and sometimes a little longer. This variation in time, of course, is due largely to the fluctuations in temperature during the different seasons of the year. No attempt has been made to find the effects of moisture or the direct rays of the sun upon incubation.

The method of hatching is similar to that of many other pentatomids. The nymph escapes through a circular opening at the cephalic or head end of the egg by opening the disc-shaped cap or lid. The lid is opened by means of a T-shaped structure called the egg-burster or lid-opener (Fig. 16), the cap usually remaining attached to one side of the egg-shell. By means of pressure from below, the lid is loosened and forced upwards and the head of the nymph, surmounted by the egg-burster, gradually makes its appearance beneath the partially opened lid, the legs and antennae being closely appressed to the ventral surface of the body and directed posteriorly. The emergence is rather slow, the nymph gradually working its way out until the antennae and legs are free and only the tip of the abdomen remains in the egg-

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shell. The nymph is thus held in an erect position, but, as soon as the antennae and legs are capable of free movement, the nymph pulls the tip of the abdomen out of the egg-shell and walks to one side of the cluster or slightly off of it. Here it remains quiet in a resting position with the other newly hatched nymphs (Fig. 17) for a few days. The hatching of an egg cluster usually takes place irregularly, thereby giving room for the movement of the appendages while the emerging nymph is held in an erect position. Normally, about five or six minutes are consumed from the time the nymph makes its appearance beneath the partially lifted lid until it has entirely escaped from the egg, the entire egg-cluster generally hatching in about an hour and a half. The egg-burster or lid-opener (Figs. 13 and 16) usually falls back in the egg-shell, being attached to one side by a thin, delicate membrane. Sometimes both the egg-burster and the disc-shaped lid may be entirely removed from the egg-shell during hatching.

Nymphal Instars*

The immature form is represented by five nymphal instars. Each of these instars is quite distinct and displays characters and color patterns which are sufficient to discriminate the instar. The antennae of the nymphs are each composed of four segments, the adult having five. No wings are present, the fifth instar having only wing-pads. In moulting or shedding its skin the outer skin splits open on the dorsal surface along the median line of the head and thorax and the nymph gradually works its way out, leaving the old cast-off skin behind. The nymph moults five times before reaching the adult state.

First Instar.—At the time of hatching the nymph is slightly longer than the egg, oval in outline, strongly convex, and with the antennae and legs quite stout. The general color is light yellowish orange with the eyes and a broad inverted v-shaped mark on the head crimson. Sometimes, there are traces of crimson lines on the thorax and abdomen. The legs, antennae and beak are without much color and nearly transparent.

In a short time the general color gradually grows darker and the color markings begin to make their appearance. The mature form, just before moulting, is about 1/16 of an inch long and 1/23 of an inch wide. The eyes are deep red and the broad inverted v-shaped area on the head is either crimson or brown. The thorax is brown, with the central portions of pro- and mesothorax yellow. The abdomen is generally darker than the head and thorax, being mostly dark brown or nearly black. On either side of each segment there is a nearly semicircular, yellowish or yellowish-brown spot. The three somewhat rectangular areas, the anterior one much narrower than the others, are dark reddish brown. In addition to these markings there are usually four white or cream-colored spots on the abdomen.

*For a technical description of the different nymphal instars, see Jones, 1918, pp. 8-11.

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The body beneath is yellow tinged with red, becoming darker on the abdomen. The semicircular, yellowish spots, as noted on the dorsal surface of the abdomen, are usually present. The legs, antennae and beak are light yellow, the tip of each dusky.

During the first instar the nymphs normally cluster together (Fig. 17) near or on the egg-shells. No individuals have been observed to feed while clustered. Just before or subsequent to moulting, the nymphs become active, scatter more or less and begin to feed. The nymphs, like the adults, greatly prefer the tender growing shoot and especially the developing fruit as food.

Second Instar.—The mature form in this instar is about ⅛ of an inch in length and nearly 1/12 of an inch in width. The head and thorax are black, the latter with two yellow spots on either side near the outer edge. The abdomen is reddish black with a number of light spots which are either whitish or light yellow. The eight semicircular spots on either side of the abdomen, one on a segment, are black. The body beneath is black, the abdomen becoming reddish with the tip black. Some color spots, corresponding to those on dorsal surface, are also present. The legs and beak are entirely black. The antennae are black, except for red areas between the second, third and fourth segments.

Third Instar.—In the third instar the shape and color pattern is much the same as in the previous instar. Sometimes, however, the black may be mostly replaced by olive green. The mature form is slightly variable in size, being about 1/7 inch in length and 1/10 inch in width.

Fourth Instar.—The general form and shape in this instar does not differ from the preceding, except that there is a greater variation in the size of different individuals. The average form is about ¼ inch in length and slightly more than 1/6 inch in width. In the fourth and fifth instars there are two color forms, the light color form and the dark color form. There are, of course, intermediate color forms that connect up the light and dark forms.

Light color form: The head and thorax are pale green with a few scattered black dots and black markings and black outer margins. The pro- and mesothorax have orange-colored areas on each side. The eyes are black. The abdomen is a shade darker green than the head and thorax, darkest around salmon-colored areas. A row of two or three spots on median line, a row of five spots on each side of median line, and another row of six spots on either side close to the connexivum are white. The salmon-colored areas, two on median line and six near either outer margin on connexivum, are bordered with black. Head and thorax are pale green beneath, bordered with black, the thorax with black dots and lines and with an orange-colored space near the inner border. The last two segments of the beak and the tibiae and tarsi of the legs are fuscous. The first segment of the antennae is mostly light green and the others fuscous.

Dark color form: The general color is dark brown to nearly black. The white spots on the abdomen are about the same as in the light form, but the salmon-colored areas are wanting. The thorax contains two yellowish areas, one on pro- and the other on mesothorax; each side of thorax and the latteral lobes of the head are sometimes yellowish. The legs, antennae and beak are greenish black. The body beneath is greenish black, the abdomen yellowish tinged with red and margined with greenish black. The thorax has light yellowish areas on both the pro- and mesothorax and the abdomen has a row of five greenish black spots on the median line.

Fifth Instar.—The shape in this instar is about the same as in the others, but the wing pads are now quite conspicuous and cover the basal portion of the abdomen. The size is quite variable in different specimens, the average individual being about 2/5 of an inch long and ¼ of an inch wide.

Light color form (Fig. 18): The head, thorax and wing pads are pale green with black borders on the sides, a few black dots and other markings. The abdomen is pale yellowish green with the rose-colored spots on median line and connexivum black-bordered. The other spots are yellowish white and not so prominent as in the preceding instar. The body beneath is

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about the same as in the light colored form in fourth instar, the abdomen differing in having a rose-colored area along the outer black border.

Dark color form (Fig. 18): The dorsal surface of the thorax is usually a little darker than indicated in the figure. The general color is dark brown to nearly black, the abdomen becoming darker. The lateral lobes of the head are orange-colored and there are also orange-colored areas on the thorax. The rose-colored area and white-colored spots on the abdomen are about the same as in light colored form. The head and thorax beneath are olive green with black markings, the latter having also orange areas. The abdomen beneath is light yellow somewhat tinged with red and margined with black. There is a row of four greenish black spots along the median line and rose-colored areas, corresponding to those on the dorsal surface, of the connexivum. The legs are olive green, becoming darker to black towards the tips.

Length of Instars

Table 1.—Table 1 is based on individuals reared in separate breeding cages in the insectary. The food consisted of green tomatoes and pods of radishes and cowpeas. The cages were placed on a table just out of the direct rays of the sun and the food changed every two or three days. The cages were examined and records taken twice a day, about 8 o'clock in the morning and 5 o'clock in the afternoon. The temperature, moisture, sunlight and food supply were as near alike in each cage as could be obtained in a laboratory without control apparatus. The records of different individuals in either lot A or lot B will indubitably prove that it is not safe to assume that an individual, which moults first from a single egg cluster, will continue to moult first in succeeding instars until it reaches the adult state. All nymphs from any one egg cluster usually spend the same or about the same amount of time in the first and second instars, but the period of time for the other instars is quite variable.

In lot B of Table 1 two specimens (cages number 8a and 9a) passed the egg and nymphal instars in 28 days. This was the minimum record for the summer. In the same lot another individual (lot B, cage number 2a) required 48 days to pass through the same stages under similar conditions.

The minimum time for the different instars, when based on different individuals in table 1, is as follows: 1st instar—3 days; 2nd instar—3 days; 3rd instar—1 day; 4th instar—4 days; 5th instar—3 days. This gives a total of only 14 days for the nymphal stages, but, as this is based on several individuals, it probably does not hold true for one individual. 24 days is the minimum time secured for one nymph to pass the five instars (from the same table). The period for the different instars is much lengthened during cool weather of spring and fall.

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TABLE 1.—LENGTH OF INSTARS OF NEZARA VIRIDULA BASED ON INDIVIDUALS REARED IN SEPARATE BREEDING CAGES.

Lot A (all from one egg cluster).

Cage No.	Eggs		Period of Incubation	Date of Moulting and Number of Days in Different Instars										Total No. of Days from Egg to Adult
				First		Second		Third		Fourth		Fifth		
	Laid	Hatched		Moult	Instar	Moult	Instar	Moult	Instar	Moult	Instar	Moult	Instar	
1	May 20	May 25	5 days	May 28	3 days	June 3	6 days	June 5	2 days	June 13	8 days	June 26	13 days	37 days
2	May 20	May 25	5 days	May 28	3 days	June 3	6 days	June 6	3 days	June 14	8 days	June 23	9 days	34 days
3	May 20	May 25	5 days	May 28	3 days	June 3	6 days	June 8	5 days	June 17	9 days	June 23	6 days	34 days
4	May 20	May 25	5 days	May 28	3 days	June 4	7 days	June 5	1* day	June 15	10 days	June 22	7 days	33 days
5	May 20	May 25	5 days	May 28	3 days	June 4	7 days	June 1	3 days	June 19	12 days	June 30	11 days	41 days
6	May 20	May 25	5 days	May 28	3 days	June 4	7 days	June 9	5 days	June 15	6 days	June 22	7 days	33 days
7	May 20	May 25	5 days	May 28	3 days	June 3	6 days	June 9	6 days	June 17	8 days	June 26	9 days	37 days
8	May 20	May 25	5 days	May 28	3 days	June 4	7 days	June 15	11 days	June 19	4 days	June 30	11 days	41 days
9	May 20	May 25	5 days	May 28	3 days	June 1	4 days	June 6	5 days	Died				
10	May 20	May 25	5 days	May 28	3 days	June 3	6 days	June 5	2 days	June 13	8 days	June 26	13 days	37 days

Lot B (all from one egg cluster).

1a	May 31	June 4	4 days	June 7	3 days	June 17	10 days	June 24	7 days	June 30	6 days	July 7	7 days	37 days
2a	May 31	June 4	4 days	June 7	3 days	June 17	10 days	June 24	7 days	June 29	5 days	July 18	19 days	48 days
3a	May 31	June 4	4 days	June 7	3 days	June 16	9 days	June 21	5 days	June 26	5 days	July 6	10 days	36 days
4a	May 31	June 4	4 days	June 7	3 days	June 16	9 days	June 21	5 days	June 28	7 days	July 7	9 days	37 days
5a	May 31	June 4	4 days	June 7	3 days	June 20	13 days	June 26	6 days	July 5	9 days	Died		
6a	May 31	June 4	4 days	June 7	3 days	June 13	6 days	June 20	7 days	June 26	6 days	July 12	16 days	42 days
7a	May 31	June 4	4 days	June 7	3 days	June 12	5 days	June 17	5 days	June 24	7 days	July 2	8 days	32 days
8a	May 31	June 4	4 days	June 7	3 days	June 11	4 days	June 15	4 days	June 22	7 days	June 28	6 days	28 days
9a	May 31	June 4	4 days	June 7	3 days	June 15	8 days	June 17	2 days	June 21	4 days	June 28	7 days	28 days
10a	May 31	June 4	4 days	June 7	3 days	June 18	11 days	June 29	11 days	Died				
11a	May 31	June 4	4 days	June 7	3 days	June 11	4 days	June 17	6 days	June 26	9 days	June 29	3 days	29 days
12a	May 31	June 4	4 days	June 7	3 days	June 10	3 days	June 18	8 days	Died				

*This nymph moulted in the morning of June 4th and in the afternoon of June 5th, giving about 30 hours for the third instar.

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Control

Natural Enemies

Many natural enemies prey upon the southern green stink-bug and often assist in keeping down the great numbers of this pest. These enemies are represented by parasites on both the adults and the eggs, by predaceous insects and by some insectivorous birds.

Parasites

The most important natural enemies are the dipterous, or two-winged, parasites on the adults. The larvae or maggots of these dipterous insects, or flies, live inside of the host during their development. Here each maggot feeds upon the tissues of the host, usually avoiding the destruction of the vital organs until it is fully matured. Then the full-grown maggot works its way out of the old carcass of its host, in all cases observed at the posterior end of the body or anal opening, and seeks shelter a little beneath the surface of the ground. In about an hour or so the outer skin of the maggot hardens into a brown case, inside of which it changes into a pupa. (The pupa is the resting or transformation state in which many insects undergo that wonderful change from larva to adult). In a few days the pupa changes into an adult fly which breaks through the brown case, or puparium, and emerges. The breeding of many dipterous parasites is quite rapid and, in the species discussed herein, there are several generations in a year.

Several hundred nymphs in each of the five different instars were collected in the field and reared in cages in the laboratory. Only a few nymphs in the fifth instar bore tachinid eggs, but no parasites were bred from these or other nymphs nor from adults which had been reared from nymphs collected in the field.

The eggs are also parasitized by small hymenopterous insects or four-winged flies.

A number of years ago adults of the southern green stink-bug, which had been killed by parasites, were reported by Franklin from Apopka, Florida, in Hubbard (1885, p. 162) who states: "The green bug has a parasite. I do not know what, but I frequently find their shells with the insides devoured out. * * *" Several years later, Morrill (1910, p. 83) states "Of 39 specimens collected by Mr. Hooker at Quincy, Fla., in stages susceptible to parasitism by tachinids, in only one instance was a tachinid egg found attached to a bug. This bug was in the fifth nymphal

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instar and became adult 4 days after the egg was first observed and died 10 days later, but upon dissection no evidence of the presence of an internal parasite could be found."

Family Tachinidae

Trichopoda pennipes Fabricius (Fig. 25)

This dipterous parasite was first reported by Watson (1918, p. 261) and a month later by Jones (1918, p. 22) as a common parasite on the southern green stink-bug, *Nezara viridula*. It is probably the internal parasite that had preyed upon the adults noted by Franklin in Hubbard, also which had laid the eggs noted by Morrill.

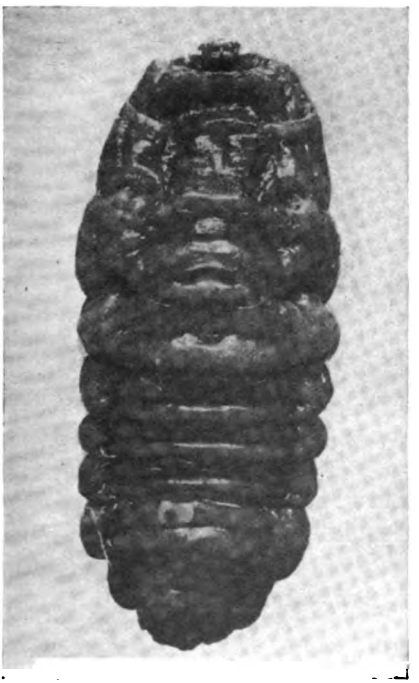

Fig. 23.—Mature maggot of tachinid parasite (*Trichopoda pennipes*). Greatly enlarged. (Photo by author.)

Undoubtedly, this tachinid fly is by far the most important enemy of the southern green stink-bug in Florida. From 10 to 80 per cent of the adults taken in the field during the summer of 1918 at Gainesville bore tachinid eggs. 800 adults, collected on radish, collard, cowpea and rattlebox during the latter part of May, June and July, were brought in from the field and placed in breeding cages in the laboratory. 38 per cent of these specimens were killed by internal parasites, and of these 31 per cent by *Trichopoda pennipes* (Figs. 23, 24 and 25). In a few cases eggs of this parasite were noted on nymphs in the fourth and fifth instars, but no parasites were reared from these nymphs. However, a few parasites were bred from adults collected in the field that bore no tachinid egg-shells, but it was impossible to determine whether the egg-shells had been dislodged before the insects were captured or whether they had been cast off with the last nymphal skin in moulting. There seems to be no reason why the larger nymphs should not be sus-

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ceptible to parasitism; provided the eggs of the parasite are deposited in time to hatch and for the larvae to penetrate the body of the host before the nymphal skin is cast off during moulting.

This tachinid fly is also a parasite on many other large plant-feeding bugs. Specimens have been bred from the common squash bug, *Anasa tristis*, in New Hampshire by Weed and Conradi (1902, p. 20). Chittenden (1902, p. 25) reared it from the northern leaf-footed plant bug, *Leptoglossus oppositus* (Say). Both of these plant-feeding insects are not uncommon in Florida. In addition to the southern green stink-bug the author bred it from the following insects in Florida: The green soldier-bug, *Acrosternum* (*Nezara*) *hilaris* (Say), Gainesville, July 26 and August 10; the green stink-bug, *Acrosternum pennsylvanicum* (DeG.), Fort Myers, August 8; the squash bug, *Anasa tristis* (DeG.), Gainesville, July 20; the banded leaf-footed plant-bug, *Leptoglossus phyllopus* (Linn.) Fig. 34, Gainesville, July 15, and a large coreid, *Archimerus calcarator* (Fabr.), Homestead, July 18.

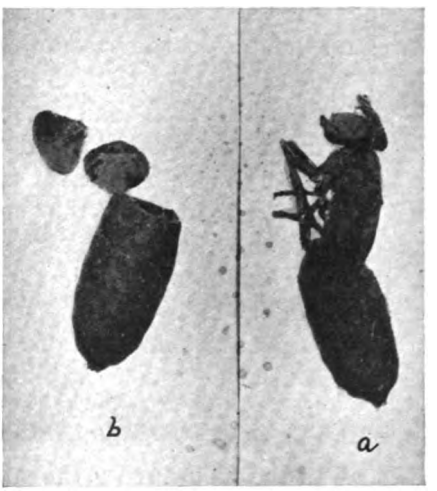

Fig. 24.—(*a*) Adult tachinid fly (*Trichopoda pennipes*) escaping from pupa case; (*b*) empty pupa case or puparium.

Quite frequently during July and August the adults of the banded leaf-footed plant-bug, *Leptoglossus phyllopus* (Fig. 34) were noticed with the eggs of this tachinid fly attached to their thorax and other parts of their body. These specimens were feeding on cowpeas that were badly infested by the southern green stink-bug. During the first week in August the eggs of this parasite were also noted on two species of the large big-footed plant bugs, *Acanthocephala femorata* (Fabr.) and *Acanthocephala declivis* (Say).

Notes on the Life History of the Parasite

The Adults.—Both the male and the female of *Trichopoda pennipes* (Fig. 25: a, male; b, female) are somewhat variable in

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size, ranging from about 1/3 to ½ inch in length. The general color is black with a yellowish or reddish-yellow abdomen. The thorax in front is beautifully marked with alternating lines of black and golden yellow. In some specimens the color markings on the thorax are not very distinct. The front of the head is whitish with a golden yellow stripe adjacent to the inner side of each eye. The sexes are readily distinguished by color markings.

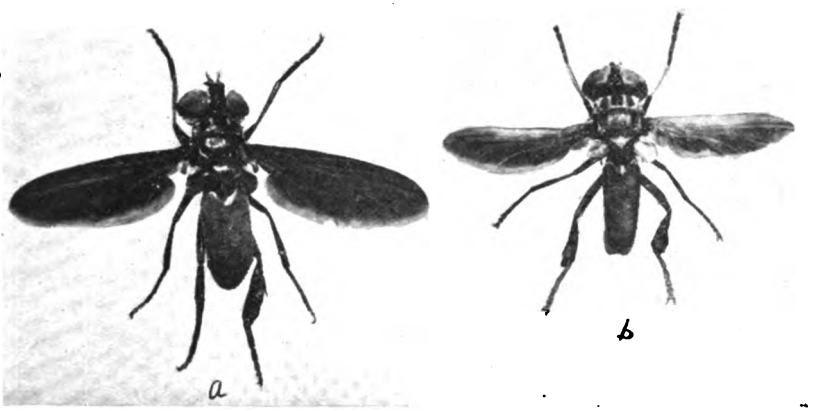

Fig. 25.—(a) Adult male and (b) female tachinid fly (*Trichopoda pennipes*). Enlarged (Photo by author).

In the male the tip of the abdomen is black and the wings are entirely black. The abdomen of the female is entirely yellowish or reddish-yellow and the wings are margined with yellowish on about one-half of the basal portion of the anterior margin. The legs are black, except a yellow basal portion, in both sexes.

This parasite is a nectar loving insect and both males and females are attracted to the blossoms of several wild plants. On bright sunny days they may be seen flying among the flowers and searching for the nectaries. Numerous specimens have been collected by the writer at Gainesville, Florida, on the flowers of the following plants: Chinquapin, *Castanea pumila* (L) Mill., a few specimens during the first and second weeks in May; basswood or linden, *Tilia americana* L., a few specimens during June; rattle-box, *Crotalaria usaramoensis* (Fig. 36), very common during July, August and September; Angelica tree, *Aralia spinosa* L., numerous specimens during July and August; pepper-vine, *Cissus (Ampelopsis) arborea* (L) thoroughwort, *Eupatorium* sp., common during October and November (Watson).

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The blossoms of rattle-box, *Crotalaria usaramoensis*, seem to exert the greatest attraction to this parasite and many specimens were noted visiting the flowers during July, August, and September. A number of the parasites were captured while they were visiting the bloom of rattle-box, and the contents of their digestive organs studied in the laboratory. In some specimens the entire alimentary canal was removed and the contents studied by means of the compound microscope. In other specimens the

Fig. 26.—Adult sarcophagid parasite (*Sarcophaga sternodontis*). Much enlarged. (Photo by author).

contents of the digestive organs were washed out in water and tested for sugar by means of Fehling's solution. No pollen grains were observed under the microscope, but Fehling's solution showed the presence of sugar. The contents of the alimentary canal were not studied for other flowers.

Distribution.—This parasite, no doubt, occurs throughout the entire state of Florida. Johnson records the species from St. Augustine, Georgiana (July), Lakeland (May 6) and Charlotte Harbor (January and April.) The author bred many

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specimens from insects at Gainesville, also from specimens sent in from Fort Myers and Homestead. According to the records cited by Aldrich (1905, p. 425) this Tachinid fly occurs in the West Indies, Mexico, and Eastern United States (Grinsby, Canada to Florida; Florida to southern California).

During copulation both sexes face in the same direction, the male being uppermost. The process closely resembles that of the ordinary house-fly. Mating usually takes place while the pair is resting on some foliage, but in one instance a pair was observed on the wing with both sexes actively flying (hovering) near the flowers of rattle-box. The period of duration, as timed in the breeding cages, was found to vary from about one to twelve minutes. Observations show that coition is repeated several times, even during the egg-laying period.

Fig. 27.—The Florida predaceous bug (*Euthyrhynchus floridanus*). Enlarged. (Photo by author.)

The egg (Fig. 21) is ellipsoidal in form, the attached side being flat and the opposite strongly convex. The outer surface is glistening and minutely sculptured with traces of hexagonal markings. It is about 1/45 inch in length and 1/70 inch in width. At the time of deposition, the egg is whitish in color, but it soon changes to a darker or grayish hue. A gluey liquid accompanies the egg which quickly hardens in the air and firmly glues the egg to the body of the host. The eggs are laid singly, only one egg being placed at a time on the host. However, there seems to be no discrimination as to where the egg is placed on the body; and a female will not hesitate to deposit an egg on a bug that already bears one or more tachinid eggs. Most of the adults in the field bore only one tachinid egg, but it was not uncommon to find two, three, four or even five eggs on a single individual. Where the flies were rather numerous, I have found as many as eight eggs upon a single host.

The number of eggs on a bug seems to depend largely upon the number of times a female tachinid fly, either the same female

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or other females, happen to come in contact with the body of the bug. This was nicely illustrated in the breeding cages. On July 15 a pair of tachinids was placed in a breeding cage containing twelve reared adults of *Nezara viridula*. During the afternoon the female deposited eggs as follows: No eggs on two bugs, one on two, three on one, four on two, and five on two. Both male and female died during the following night; upon dissection 17 eggs in various stages of development were found within the body of the female. Although this gives a total of 46 eggs; it probably does not represent the entire number of eggs laid by this female as she may have deposited several eggs before the pair was collected in the field (62 eggs have been found in the body of a single female that was taken in the field while depositing eggs). In other breeding cages several pairs of *Trichopoda pennipes* were confined with numerous reared specimens of the southern green stink-bug. In all cases the tachinid flies were taken while copulating in the field. In depositing an egg the female tachinid, as she crawls over a bug, quickly lowers the tip of her abdomen and places an egg on the bug. The bugs seem to pay no attention to the tachinids. In fact their presence does not seem to disturb or annoy them at all. In one cage 22 eggs were deposited on a single specimen of *Nezara viridula* (Fig. 21), 16 being on the dorsal surface of the body. In the field and in the breeding cages eggs have been deposited upon the eyes, legs, head, thorax, wings, abdomen, and ventral surface of the body of the host. The location of the egg seems to depend upon where the female parasite chances to pass over the host. Neither the female tachinid nor the host pays any attention to the eggs after they have been deposited.

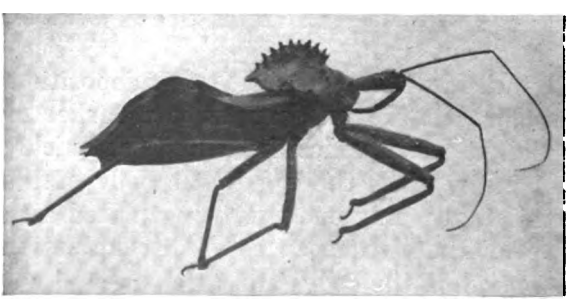

Fig. 28.—The predaceous wheel-bug (*Arilus cristatus*). Enlarged. (Photo by author.)

Upon hatching the minute young maggot makes a very small hole through the flat or attached side of the egg into the host. In figure 22 the egg shell has been removed to show the hole through the exoskeleton made by the tiny maggot in entering the

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host. This hole is greatly enlarged in the picture. No other hole or opening, except one through the attached side of egg-shell, is made by the maggot in escaping from the egg. The maggot or larva lives, feeds and grows on the inside of the host until it is full-grown. The mature maggot then works its way out of the body of the host at the posterior end of the abdomen and buries itself in the ground. The host dies a little before or soon after the mature maggot leaves its body. The incubation of the egg and the development of the maggot within the body of the host required from 17 to 24 days. Eggs have been observed to hatch in two or three days. Eggs of this tachinid fly have been observed on *Nezara viridula* during the months of April, May, June, July, August, September, October, November and December. The adult flies have also been seen in the field during these months and March at Gainesville. No records have been made during the other months.

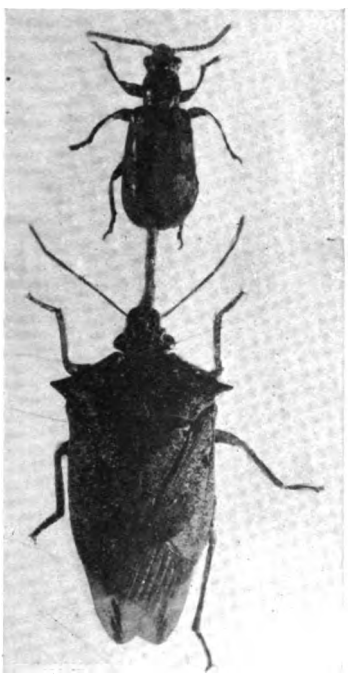

Fig. 29.—The spined soldier-bug (*Podisus maculiventris*) killing a beetle. Enlarged. (Photo by author).

The mature larva or maggot (Fig. 23) is light yellowish white in color and varies from about ⅜ to ½ inch in length. After descending into the soil the maggot prepares for the transformation into the winged fly. It contracts slightly, assumes a regular ovoid shape, and forms a pupacase or puparium in a very short time. When placed in a glass vessel and forced to pupate under aerial condition, the larva would crawl about for a time seeking suitable conditions to pupate. However, after crawling about for an hour or two the larva will transform to the pupa state in the open. The puparium or pupa-case is nearly smooth, ovoid in outline, brown in color and a little shorter than the mature maggot. Within the pupa-case or puparium many complicated

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changes take place during which legs, wings, eyes, hairs, mouth-parts, and other structures of a winged fly slowly make their appearance. The pupa stage lasts from eleven to thirteen days, twelve days being the average time. When fully formed, the mature tachinid fly (Fig. 25) by means of dilations of its face, pushes off the lid-like portion of the anterior end of the puparium (Fig. 24) and in a similar manner works its way up through the soil. In about a half hour or a little longer the body is entirely hardened, the wings fully expanded, and the color markings fixed to that of the adult. It is rather interesting to note that the

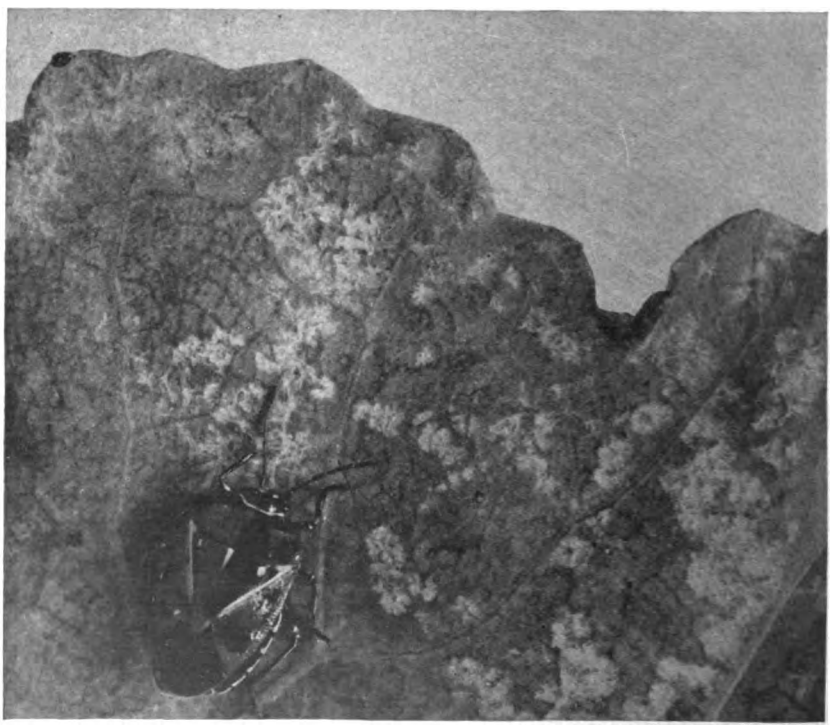

Fig. 30.—The harlequin cabbage-bug (*Murgantia histrionica*) feeding on collard leaf. Note large whitish areas caused by feeding. Slightly enlarged. (Photo by author).

emergence of this parasite as well as that of the other dipterous parasites generally took place in the morning, principally between eight and ten o'clock.

Only one mature maggot of *Trichopoda pennipes* (Fig. 23) was bred from a single host, even when the host bore a number of the eggs of the parasite.

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Trichopoda lanipes Fabricius

Only one example of this tachinid fly was reared during the summer. It was bred on August 8th from a specimen of the southern green stink-bug, *Nezara viridula,* that had been sent in from Fort Myers, Florida. The species can readily be separated from *Trichopoda pennipes* by its entirely black legs and abdomen.

This tachinid fly is rather common in the vicinity of Gainesville and it is also attracted to the blossoms of wild flowers. Prof. P. W. Fattig and the author captured a few specimens while they were flying among the flowers of the angelica-tree, *Aralia spinosa*

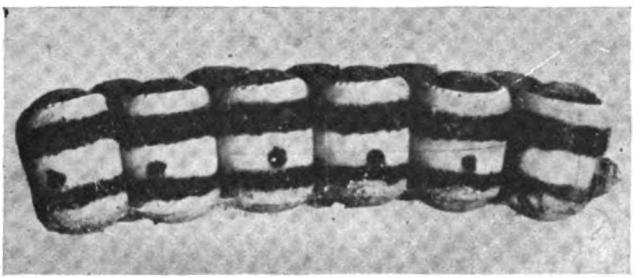

Fig. 31.—Lateral view of the eggs of the harlequin cabbage-bug (*Murgantia histrionica*). Greatly enlarged. (Photo by author).

L., and the pepper-vine, *Cissus arborea,* during the latter part of July and August. Prof. Watson collected it on basswood blooms in May. No specimens were reared from insects collected at Gainesville.

Family Sarcophagidae

Sarcophaga sternodontis Townsend (Fig. 26)

In general appearance and size this two-winged parasite very much resembles the omnipresent house-fly. It ranks next to the tachinid fly, *Trichopoda pennipes* (Fig. 25), as a natural enemy of the southern green stink-bug, about six per cent of the adults being killed by this parasite at Gainesville. As in the other parasites, the larva or maggot lives within the body of the host and feeds upon the internal tissues of the host throughout its development. When fully matured, the maggot crawls out of the posterior end of the abdomen and seeks shelter a little beneath the surface of the ground to pupate. Usually, only one maggot lives within the body of the southern green stink-bug, but in a few cases two maggots were reared from one specimen. In larger insects a number of maggots often live within the body of the same host at the same time, three being reared from one

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specimen of a large coreid (Fig. 33), *Corecoris confluenta* (Say), in the last nymphal instar and twenty-six from four specimens of the large lubber-grasshopper. When two or more maggots live within the body of one host, they mature at the same time; this seems to indicate that they are practically of the same age.

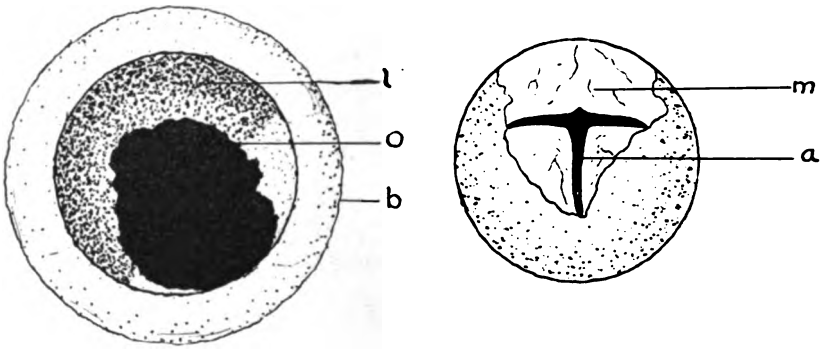

Fig. 32.—Dorsal aspect of eggs of harlequin cabbage-bug: *l*, lid, or cap; *b*, outer wall or barrel of egg-shell; *o*, opening made by egg-parasite through lid in escaping from egg-shell; *a*, egg-burster used by nymph in opening lid of egg-shell; *m*, membrane. (Drawn by Wessel.)

The full-grown maggots usually leave the body after the death of the host, the time varying from one to six days. Occasionally, a mature maggot has been observed to crawl out of the posterior end of the abdomen a few hours before the death of the host. The full-grown maggot is dirty grayish white in color and about three-eighths of an inch in length. The pupa case or puparium is a little shorter than the mature larva, nearly smooth, reddish brown in color, and ovoid in form. The pupa state lasts from seven to ten days, eight days being the average time. When fully formed, the adult fly, by inflating the ptilinum, pushes open, or off, a lid-like portion of the anterior end of the puparium, works its way out of the opening thus formed, and then up through the ground. In a remarkably short time, usually within a half hour, the wings are wholly expanded and the body perfectly indurated.

According to Aldrich (1905, p. 514) this sarcophagid has been bred from a cerambycid beetle, *Sternodontis damicornis*, and from a scorpion, *Centurus edwardsii*, in Jamaica, West Indies. In Florida, Aldrich (1916, p. 267) states that it has been reared from the American locust, *Schistocerca americana;* the large lubber-grasshopper, *Dictyophorus reticulatus;* and the larva (hickory horned devil) of the regal moth, *Citheronia regalis*. In addition to the many records of specimens bred from

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the southern green stink-bug, the author has reared the parasite from the following insects in Florida: The northern green soldier-bug, *Acrosternum hilaris* (Say), 3 specimens, Gainesville, June 10; the harlequin cabbage-bug, *Murgantia histrionica* (Hahn) (Fig. 30), 5 specimens, Gainesville, June 20 and 21; the brown stink-bug, *Euschistus servus* (Say), 6 specimens, Bulow, June 12 and 1 specimen, Gainesville, June 27; a very large coreid, *Corecoris confluentus* (Say) (Fig. 33), 4 specimens from two nymphs, Homestead, July 26, and the large lubber-grasshopper, *Dictyophorus reticulatus* (Thumb), 26 larvae from 4 adults, Putleta, July 28.

Other Dipterous Records

One specimen of *Muscina stabulans* Thumb (family Muscidae) and several specimens of *Fannia femorata* Lw. (family Anthomyiidae) were reared from several dead specimens of the southern green stink-bug on June 15. My records seem to indicate that both of these flies are scavengers instead of parasites. The cover of the glass breeding cage had been accidentally removed and it seems that in all probability the specimens became infested after death. No examples of either of these species were bred from other breeding cages or living hosts. A little humpbacked fly, *Phora scalaris* Loew, was found breeding in dead specimens which had been placed in waste jars; it was also noted breeding in decaying vegetation.

Fig. 33.—A large plant-feeding bug (*Corecoris confluentus*). Slightly enlarged. (Photo by author).

Egg Parasites

Occasionally, the eggs of the southern green stink-bug are parasitized by minute four-winged insects that are commonly known as chalcid flies. They belong to the superfamily Chalcidoidea of the order Hymenoptera.

The female egg-parasite, with the aid of her ovipositors, makes a tiny hole through the shell of an egg (host) and then, through the opening or hole thus formed, places one of her own eggs on the inside. Here her egg hatches and the young maggot-like

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larva, feeding upon the contents of the egg, lives and grows until it is fully matured. Pupation also takes place within the egg-shell. In a very short time a minute four-winged fly is formed within the pupa case. This fly works its way out and escapes from the egg or host by eating an irregularly-shaped hole thru the cap or disc-shaped lid (Fig. 16). In all cases observed the mature egg-parasites emerge after the non-parasitized eggs have hatched.

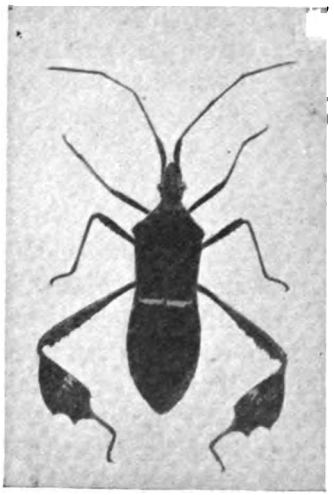

Fig. 34.—The banded leaf-footed plant-bug (*Leptoglossus phyllopus*). Enlarged. (Photo by author).

During the last two weeks in May and the first week in June, 40 egg clusters of the southern green stink-bug were removed from the leaves of radish and collard in the field and placed in small, low stender dishes with ground glass covers. In most cases a small portion of the leaf was removed with the egg cluster so as not to injure or destroy any of the eggs. The eggs were in various stages of development, many of the clusters being almost ready to hatch. These 40 clusters contained 3544 eggs, averaging a little better than 88 eggs to a cluster. 3 mature parasites were reared from these eggs and 581 of them failed to hatch or over 16 per cent of the total number of eggs failed to develop. Of the 581 eggs, most of them seemed to be unfertile, a few contained parasites that failed to escape, and several contained nymphs that died just before hatching. On the other hand, some of the eggs may have been destroyed under the artificial conditions in the insectary. However, it was not at all uncommon to find several eggs in a cluster that had failed to develop outdoors under natural conditions. The 3 mature parasites were determined by Mr. Gahan of the United States Department of Agriculture as a new species belonging to the genus *Ooencyrtus* of the family *Encyrtidae.*

Many other egg clusters were incubated in the insectary or examined in the field after hatching, during the summer, and only two others showed evidences of egg-parasites. A cluster of 95 eggs, found on the underside of a cowpea leaf, about the middle of July, a few days after hatching contained four eggs with the

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characteristic hole or opening (Fig. 16) of the parasites in the lid and 14 eggs that had failed to incubate. The other egg cluster was removed from the underside of a leaf of rattle-box (Crotalaria) a few days after deposition and the incubation period completed in the insectary. Out of the 99 eggs in this cluster, 12 mature parasites were reared and the rest of the eggs were all fertile and hatched perfectly. As these 12 egg-parasites were all males, Mr. Gahan states that it is impossible to give even a generic name for them, but that they belong to the Chalcidoid subfamily Eupelminae.

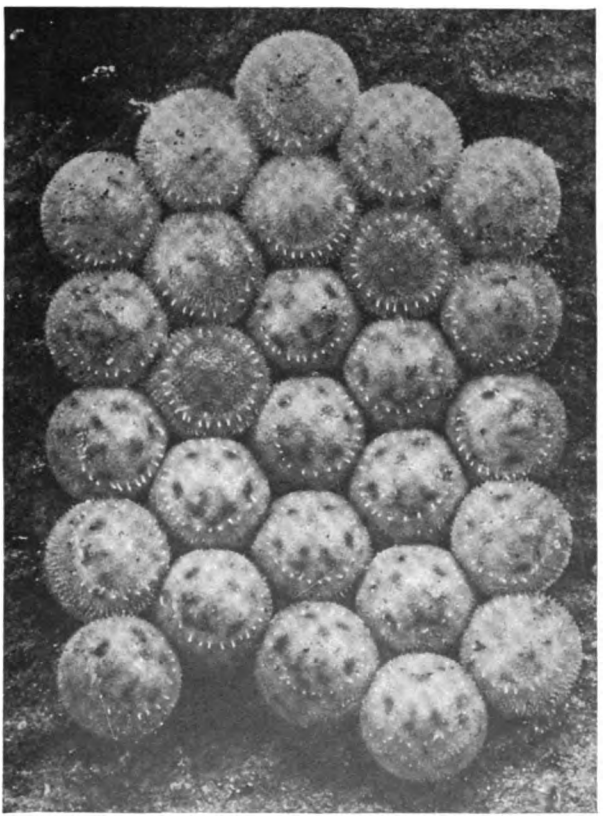

Fig. 35.—Eggs of the brown plant-feeding stink-bug (*Euschistus servus*) on an orange leaf. Greatly enlarged. (Photo by author).

According to Morrill (1910, p. 82) and Whitmarsh (1917, p. 542) the eggs of the northern green soldier-bug, *Acrosternum hilaris*, are frequently parasitized by a proctotrypid parasite. To quote from Whitmarsh: "These small black fly-like parasites

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are most noticeable in mid-July, or at the time when the pentatomids are at the height of the egg-laying season." This egg-parasite was determined by Girault as belonging to the genus

Fig. 36.—A trap and propagating plant (*Crotalaria urasamoensis*). The plant attracts the southern green stink-bug (*Nezara viridula*) and the blossoms attract the most important parasite (*Trichopoda pennipes*). On station grounds at Gainesville. (Photo by Thompson).

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Trissolcus, probably *euschisti* Ashmead. Girault (1907, p. 30) lists *Trissolcus euschisti* as an internal parasite upon the eggs of three brown stink-bugs, *Euschistus servus* (Fig. 35), *E. tristigmus* and *E. fissilus* (*euschistoides*). The first two species are very common plant-feeding insects in Florida.

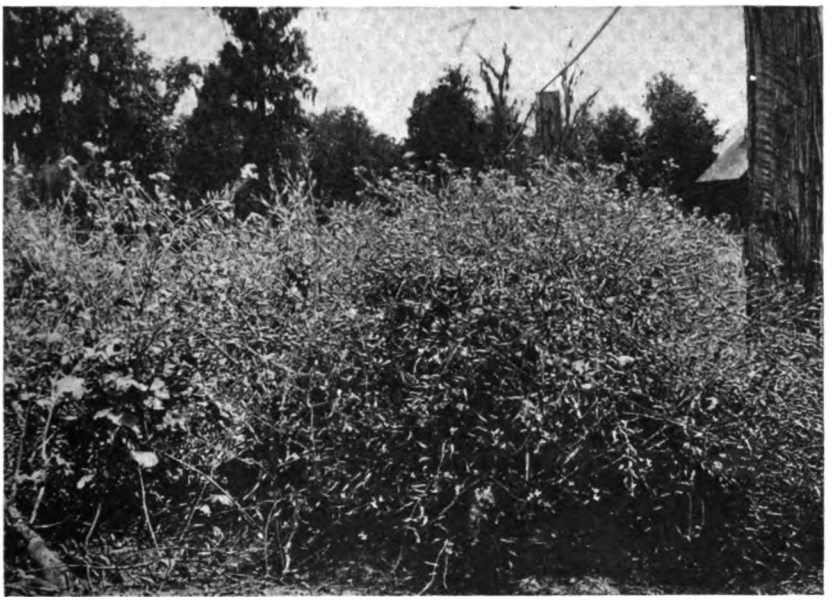

Fig. 37.—Radish plants bearing pods. Radish and collard make a good trap crop to protect tomatoes. (Photo by author).

During the months of July and August the author found that from five to ten per cent of the eggs (Fig. 31) of the harlequin cabbage-bug were destroyed by two internal parasites, *Trissolcus murgantiae* Ashmead and *Ooencyrtus johnsoni* Howard. The eggs of the southern green stink-bug, when removed from the same plant (collard) or plants growing in the same patch, failed to show any evidences of either of these parasites.

Trissolcus podisi has also been reared from the eggs of the Harlequin cabbage-bug by Morgan in Louisiana and Mississippi.

Identification of Parasites

The reared parasites or mature forms were turned over to specialists for identification. At this opportunity the writer wishes to express his appreciation to Prof. Jas. S. Hine, Ohio State University, Columbus, Ohio, for the determination of the Diptera. The Sarcophagidae were forwarded by Prof. Hine to

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Dr. J. M. Aldrich, National Museum, Washington, D. C., for identification. Through the courtesy of Dr. L. O. Howard, Mr. A. B. Gahan has very kindly determined the egg-parasites.

Predaceous Insects

Several predaceous insects prey upon the southern green stink-bug in Florida. These consist of two predatory pentatomids, three assassin-bugs or reduviids and one large wasp.

Euthyrhynchus floridanus (Linn.), the Florida predaceous bug (Fig. 27).

This is the most important predatory enemy of the southern green stink-bug, numerous records being made by the writer during May, June, July and August in the field. In most cases the predator had impaled a mature victim on its beak, the beak usually penetrating the dorsal portion of the thorax. The Florida predaceous bug is also an important enemy of many other plant-feeding insects, including the velvet bean caterpillar, and should not be destroyed.

Podisus maculiventris (Say), the spined soldier-bug (Fig. 29).

Altho very common in the fields, only two instances of this insect feeding upon the larger nymphs of *N. viridula* were noted. Jones (1918, p. 22) found it preying upon a nymph in the fifth instar in Louisiana.

Arilus cristatus (Linn.), the wheel-bug (Fig. 28).

This is another insect that preys on the southern green stink-bug. Two large nymphs of the wheel-bug were found feeding upon specimens of *N. viridula* in the fourth and fifth nymphal instars during the latter part of May. The wheel-bug is so called because of a prominent, semicircular, toothed ridge on its thorax which greatly resembles a half cogwheel.

Sinea spinipes (H. S.) and *Zelus cervicalis* Stal., assassin-bugs.

An adult of each of these assassin-bugs was found on *Amaranthus* sp. with its beak piercing the body of a nymph in the second instar.

Bicytes quadrifasciata Say, a large bembecid wasp.

According to Jones (1918, p. 23) "Mr. S. A. Rohwer of the Bureau of Entomology states that a bembecid wasp which Mr. Russell collected at St. Leo, Fla., October 22, 1907, belongs to this species. The specimen was taken while in flight with an adult of *Nezara viridula* in its mandibles."

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Birds

The food habits and stomach contents of many American birds have been carefully studied by the United States Biological Survey and others to determine their economic status in various parts of the country. The malodorous bugs, including the ill-flavored and strong-scented stink-bugs, have been found to constitute a part of the food of a number of birds. Among these birds might be mentioned the quail, the blackbird, the crow, the swallows, the flycatchers, the thrushes, the robin, etc. The northern green soldier-bug, *Acrosternum hilaris* has been found in the stomach of the quail, the robin, the cliff-swallow, the crested flycatcher and other birds. In Porto Rico, Wetmore found *Nezara* sp. in the stomach of a number of different birds. Numerous similar records have also been published for the United States.

In regard to the southern green stink-bug, *Nezara viridula*, Watson (1918b, p. 232) states "In spite of the bad smell birds occasionally eat these bugs." Chickens have also been noted by Watson (1918c, p. 90) as feeding upon this pest. During July, the writer placed a number of nymphs on the twigs of young orange trees. On the following morning a number of these twigs were without insects, probably being destroyed by birds.

A letter from Prof. Watson (Dec. 1919) states that he finds that mature chickens are very fond of the southern green stink-bug, especially after they are taught to eat them. This can readily be done by throwing a few stink-bugs to a flock of chickens which are confined. If chickens are allowed to run through a field they can be depended upon to keep the bugs down, particularly in the late fall when the bugs are usually more troublesome. Of course chickens are a nuisance in a truck patch and this remedy will have to be conducted with some discretion. This is accomplished by giving the chickens all the green stuff they will eat before turning them loose in the garden, and then only for an hour or two before roosting time so that they will not have much time to wallow. Where young chickens can be allowed to run over the garden and the old hen confined, it is much more satisfactory from the standpoint of growing vegetables. Take a coop full of chickens and move them, old hen and all, to the center of the infested area, open the coop leaving out the chickens, but keeping the old hen confined. However, the young chickens have

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to be of fairly good size before they will be very efficient catchers of the adult insects.

Climate

Climate is often considered an important factor in the control of economic insects. In Louisiana, Jones (1918, p. 23) found that specimens of the southern green stink-bug, especially nymphs, are sometimes killed by low temperatures during the winter months in the insectary; he also states that a sudden drop in temperature during this season of the year often kills individuals in the field and gives specific cases for Florida and Texas. At Gainesville, Prof. Watson states that he has never seen many adults that were killed by cold weather, but, although they sometimes find dead specimens during the winter, a careful examination of their bodies generally shows signs of parasitism. He believes that the disappearance of this insect during the winter months is due largely to stoppage of breeding, to work of parasites and to hibernation. Of course, there is undoubtedly a natural mortality (probably higher) during winter as in other seasons of the year. About one-half of the individuals seek favorable places to hibernate during cold weather and this probably accounts for the paucity of numbers often noted by growers during the winter, especially in the central and northern parts of the state.

On the whole it seems that the bioclimatic factors, as climate, weather, sunshine, topography, latitude, altitude, etc., have been well suited for the propagation and dissemination of the insect in Florida. The mild winters do not, at least, kill great numbers of the pest and it is not uncommon for serious outbreaks during early spring and summer upon cultivated plants, especially tomatoes, potatoes, beans, peas, etc.

Artificial Control

Clean Culture

There are a number of wild plants or weeds upon which the insect feeds and breeds, especially during early spring and late fall. Volunteer plants should also be classified as weeds. The preferred food plants, both wild and cultivated, belong largely to the legumes or Pulse family (Leguminosae) and to the mustard family (Cruciferae). The individuals that do not seek favorable places to hibernate during cold weather generally remain upon some member of the mustard family throughout the

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entire winter. Weeds and volunteer cultivated plants should be kept down at all times, not only in cultivated field, but in other fields and waste places. The destruction of these plants will keep down the food supply, kill many immature forms and shorten the breeding season. The remnants of field, truck, garden and cover or soiling crops should be scrupulously destroyed after the crop is harvested so as to stop breeding and destroy immature forms.

A leguminous cover or soiling crop, as beggarweed, cowpeas, etc., is generally grown during the summer in both citrus and pecan groves, the crop to be cut or turned under later on. The proper management of this cover crop upon which the insect breeds is a potent factor in controlling the pest upon either citrus or pecan trees. As stated by Watson (1917a, p. 60R) the beggarweed or cover crop should be cut with a scythe in the rows and from around the trees first, leaving the middles between the rows of trees to be cut a few days later, but not later than September 15. The immature forms will then work away from the trees to the uncut legumes, and, when the middles are cut a few days later, most of them will die before they can crawl back to the citrus or pecan trees. The cover crop should never be left to stand until fully matured, either in the entire grove or in the rows with the trees. Mature plants are unattractive to the insect and, as a rule, the insect can be kept down to a large extent by a proper cutting of the cover crop at the right time.

Trap and Decoy Crops

Of the long list of food plants field observations show that the adults prefer and are attracted largely to leguminous and cruciferous plants. To a large extent the preferred food plants can be classified into seasonal food plants, thereby giving the trap or decoy crop to use during the different seasons of the year. The leguminous plants, as cowpeas, beggarweed, rattle-box, beans, etc., are greatly preferred during late spring, summer and early fall; while cruciferous plants, as radish, rape, collard, mustard, turnip, etc., are attacked mostly during early spring and late fall. Adults that do not seek suitable places to hibernate during cold weather usually overwinter on the leaves of cruciferous plants, as Essex rape, radish, collard, mustard, etc., growing in the fields and waste places. No feeding takes place, except during the warmest hours of warm days, in the winter. Radish (Fig. 37) interplanted with collard seems to be the best trap

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crop to protect tomatoes. Radish and collard, planted about the first of November, has proven very attractive to the bugs during the tomato season of the following spring; in fact so attractive that tomatoes growing in adjoining rows or the same patch were not or scarcely at all infested. The bugs on the trap crop should be gathered by hand picking during the tomato season and both trap crop and remnants of tomato crop destroyed after the tomatoes are gathered and thus stop further breeding and destroy immature forms.

Leguminous plants are most alluring to the bugs during the pod formation period. Hand picking is undoubtedly the best method to use in gardens and truck patches for the control of the insect upon beans, peas, etc. The proper management and cutting will usually keep the pest under control where leguminous cover or soiling crops are grown. There is, of course, an overlapping of the seasonal food plants, especially during fall and spring.

Rattle-box (Fig. 36), *Crotalaria usaramoensis*, seems to offer the greatest possibilities as a trap crop for summer and fall until killed by frost. Rattle-box, or butcher-rattle, as it is sometimes called, is an herbaceous leguminous plant used in Java, East Indies, for green manuring. Two ounces of seed were received by the United States Department of Agriculture, December 26, 1917, from Buitenzorg, Java. Part of this seed was forwarded to the Experiment Station, Gainesville, Florida, during the latter part of March and planted on the station grounds on April 6, 1918. The plant is unknown to most growers in the state. Through the kindness of Prof. J. B. Thompson, Forage Crop Specialist, the following notes on rattle-box have been turned over to the writer. *Crotalaria usaramoensis* is an erect growing herb measuring from four to six feet in height with a lateral spread of three feet or more. It makes a very dense leafy growth while a profusion of bright yellow, pedicillate flowers borne on long terminal racemes gives it added ornamental value. Flowering plants may be produced in from eight to ten weeks from the seed, which may be planted as early in spring as desired after the dangers of frost are past. As an ornamental plant its value is greatly enhanced by its free blooming habits and a long blooming period that lasts all summer and is only ended by a killing freeze. It would probably succeed in winter in the southern part of the state wherever frost does not occur. This

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species is adapted to a wide range of conditions, but will thrive best on light fertile soil; and it delights in a warm location with plenty of sunshine. It is a splendid subject for planting where a quick-growing, temporary, ornamental hedge is desired. It also offers promising possibilities in farm practice for planting as a cover or soiling crop and for soil improvement purposes.

The ever-blooming and the long pod forming period adds greatly to the value of rattle-box as a trap crop. At Gainesville during the past summer (1918) the plants, from seed sown on April 6, began blooming during the early part of June and continued to blossom profusely until killed by a frost on December 28. The plant forms pods and seeds freely during July, August and September, but seeded very little after cool weather set in. Rattle-box is probably not more attractive, if as much so, than cowpeas and beggarweed, but the period of greatest attractibility to the insect is very much longer than that of other legumes on account of the extremely long period of pod formation. Like other legumes, rattle-box is not especially attractive to the bugs after the fruiting period, especially late fall.

As a trap crop rattle-box serves a twofold purpose. The blossoms exert a special attraction to many flower-visiting insects. Among these flower-visiting insects are numerous dipterous parasites, including the most important parasites of the southern green stink-bug. The tachinid fly, *Trichopoda pennipes* (Fig. 25) is a honey-loving insect and both male and female are much attracted to the blossoms of rattle-box for the nectaries. The long period of inflorescence, blooming continually and profusely from about ten weeks after seed is sown until killed by frost, is much in favor of rattle-box for attracting nectar-feeding parasites. The sarcophagid fly, *Sarcophaga sternodontis* (Fig. 26) and the tachinid fly, *Trichopoda lanipes*, both parasites of the southern green stink-bug, were not uncommon visitors to the flowers of rattle-box. Several other dipterous parasites were also noted.

Rattle-box should be grown as a propagating plant for parasites. The percentage of individuals of the southern green stink-bug that bore tachinid eggs was greater on rattle-box during the pod formation period than that of cowpeas and other leguminous plants during the fruiting season. This is readily explained by the fact that both blossoms and seed-pods are formed continuously during the summer, the blossoms attracting the parasites

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and the pods attracting the stink-bugs. The principal parasite, *Trichopoda pennipes* (Fig. 25) could always be found flying among the flowers on warm sunny days favorable to the insects.

Of 161 adult bugs collected on rattle-box, August 10, 1918, by Prof. Thompson and the writer, 110 or a little over 66 per cent bore eggs of the tachinid fly, *Trichopoda pennipes*. On August 12 all bugs were again collected on the same plot (Fig. 36); out of

Fig. 88.—Method of hand collecting on citrus trees. (Photo by Watson).

71 specimens, 57 or slightly more than 80 per cent bore eggs of the same tachinid parasite. The last record was the highest one taken during the summer. Most of these stink-bugs bore only one tachinid egg, but it was not uncommon to find two, three, four or even five on one individual. On account of the high per cent of parasitism the southern green stink-bug should not be collected on rattle-box and destroyed by hand picking. The destruction of the bugs will destroy the parasite. Rattle-box could be

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grown in plots as a propagating plant and thus increase the number of parasites.

Hand Collecting

The habit of the insect, when suddenly disturbed or when a limb is jarred, of dropping makes hand collecting profitable where valuable garden and truck crops are infested, also when citrus fruits are attacked. As the bugs are rather sluggish during cool weather, they should be gathered in early morning, or on cool or rainy days. The temperature should not be above 70° F., but a lower temperature, of course, would be much better. On potatoes, tomatoes, beans, peas, etc., the bugs should be brushed or jarred into a wide-mouthed collecting pan (preferably one with a handle) containing about an inch of water covered with a film of kerosene. The egg clusters should also be destroyed.

On citrus trees Watson (1918, p. 233 and 234) has demonstrated that the bugs can be collected economically when they are destroying the fruit or injuring young trees. For collecting the bugs on trees large nets (Fig. 38) of at least three feet in diameter and of about an equal depth were constructed. These nets should be made out of heavy muslin or preferably, good canvas.

"Each net should have a short handle which if extended across the diameter to stiffen the opposite rim will permit the use of telephone wire to complete the skeleton for the net. Bend the wire into a loop and nail the loose ends to a wooden handle.

"One man can manipulate this net, but two may work to better advantage. One places the net under a limb of fruit and the other gives the branch a quick, vigorous shake which causes the bugs to roll into the bottom of the net. After the men have finished a tree the bottom of the net is dipped in a bucket containing kerosene. This keeps the net constantly wet with kerosene.

"The work cost in one grove of ten-year-old trees set 20 by 30 feet between 50 and 75 cents an acre, and from 30 to 100 bugs a tree were collected. Two men with a net covered at least an acre in two hours.

"The labor cost $1.50 a day for each man. This is less than the cost of spraying even if a safe and effective solution were known. On larger trees with more bugs the cost is greater, but should in no case exceed $1.50 an acre,—still much less than the cost of spraying.

"For large trees not too close together and with few limbs touching the ground to prevent a ready manipulation, the nets should be larger. The writer (Watson) has used some nets 6 by 12 feet. These were suspended from a light wooden frame like those used for holding quilts or stretching curtains, the net sagging two or three feet in the center. The net should be of closely woven canvas so that insecticide oil, crude oil or kerosene can be placed in the bottom, into which the bugs will fall. Cotton waste placed in the net will absorb the oil and in rolling around will thoroughly wet the bugs. Two men will be required to manipulate the net and at least another to shake the branches.

"For large trees these nets will be found more economical than the smaller ones strung on telephone wire. They are effective, however, only at a

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temperature below 70 degrees. Above that the bugs will take to wing as they drop, beforc they strike the canvas. The use of the large nets is therefore restricted to the very early morning, to moonlight nights and to cold days. The smaller nets can be used all day, though more effectively in the early morning."

Spraying

Both Watson (1918a, p. R59-R62) and Jones (1918, p. 23-25) have demonstrated that it is not practical to use contact insecticides as a solution strong enough to kill the insect will injure or destroy the plants. Experiments with kerosene emulsion and nicotine sulphate gave negative results. A solution that will not injure the foliage of plants will not destroy all of the younger nymphs and has very little or no effect upon the larger nymphs and adults.

Nymphs and adults are both quickly killed when sprayed with pure kerosene. Badly infested weeds and remnants of cultivated plants should be destroyed, either by cutting or spraying. If the insects are mostly in the adult state, the latter method should be used.

SUMMARY

A large green stink-bug, *Nezara viridula* Linn., often becomes a serious pest upon cultivated plants in Florida. Its depredations are also well known in other southern states, but particularly in the Gulf States. The insect is of foreign origin and is almost universally distributed throughout the tropical and neotropical regions of the entire world. Its ravages have also been reported in Australia, India, West Indies, Austria and other countries.

Both nymphs and adults obtain food by puncturing the tissues of plants and then extracting the plant juices. All parts of plants are attacked, but tender young shoots and maturing fruit are greatly preferred. Among the garden, truck and soiling or cover crops injured, are tomato, Irish potato, sweet potato, beans, cowpeas, beggarweed, radish, collard, cabbage, turnip, mustard, okra, etc. In fall and early winter the insect sometimes becomes a serious pest in citrus groves, feeding especially upon the fruit, young seedlings and young shoots of older trees. Similar infestations have been reported for pecan groves.

Notes on habits and life history studies have been carried on at Gainesville, Florida. Hibernation is imperfect, about one-half of the individuals remaining upon succulent plants in the field throughout the winter months. No breeding takes place during

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the winter. Eggs have been found outdoors during the second week of April and as late as December 12. The eggs are deposited in clusters, mostly on the underside of the leaves. Some females deposited no eggs, while others laid one, two or even three egg clusters. One female laid 212 eggs, three clusters of 78, 70 and 64 eggs respectively. No eggs were found in her ovaries at death. 40 egg clusters, collected consecutively in the field, contained 3544 eggs, averaging a little over 88 eggs to a cluster. The clusters were made up of from 46 to 126 eggs.

The minimum period for incubation was 4 days. The minimum time for the five nymphal instars, based on individual records, was 24 days. This gives a total of only 28 days from the time the eggs are laid until the adult state is reached. Field records indicate that there are four generations annually at Gainesville and probably five in the southern portion of the state. Development was more rapid during the summer than either spring or fall, temperature having an important bearing upon the period of development of both eggs and nymphs. Table 1 gives the variation in time for the development of nymphs from two different egg clusters and shows that the first nymph to issue from an egg in a cluster is not always the first to reach the adult state.

Six predaceous enemies have been recorded in the field, the Florida predaceous bug *(Euthyrhynchus floridanus)* being the most important.

Three parasites of the adult and two egg parasites have been reared. Out of 800 adults of *Nazara viridula* collected in the fields during the latter part of May and the first of June, 38 per cent were killed by two dipterous parasites, 31 per cent by the tachinid fly, *Trichopoda pennipes,* and the rest by the sarcophagid fly, *Sarcophaga sternodontis.* Both of these parasites were also bred from a number of other plant-feeding insects in Florida. The egg parasites were not common at Gainesville and are represented by undescribed species.

In most cases parasitized specimens of *Nezara viridula* failed to deposit eggs before they died. In a few instances females, collected in the field, deposited eggs before they died from the effects of parasitism. Breeding experiments in the insectary show that, if the eggs are nearly or fully developed within the ovaries of *Nezara viridula* when the eggs of the tachinid fly (*Trichopoda pennipes*) are placed on her body, a female will

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sometimes deposit eggs after being parasitized. Of course, not more than this one egg cluster is laid before the insect is destroyed. Pairs have been collected while feeding and copulating in the field during the late afternoon and both sexes died from the effects of parasitism during the following night.

When valuable garden and truck crops are heavily infested, hand collecting seems to be the best control method. The proper management and cutting of the cover or soiling crop will usually keep the insects under control in citrus groves, also in pecan groves. In case of severe infestation in citrus groves it has been demonstrated (J. R. Watson) that hand collecting with large nets can be done successfully and profitably. In using large nets the work should be done in early morning or on cool days when the temperature is below 70° F. At a higher temperature many of the adult bugs will save themselves by taking flight before they drop into the nets.

Of both wild and cultivated vegetation the insects generally show a decided preference for leguminous and cruciferous plants. During late fall, winter (individuals that do not seek protected places to hibernate) and early spring the bugs often congregate upon cruciferous plants as radish, collard, Chinese cabbage, rape, mustard, turnip, etc. Some of these plants might serve as a valuable trap crop for late fall, winter and spring. Experiments at Gainesville, Florida, during the summer show that radish and collard, both growing in the same row, will serve as a trap crop to protect tomatoes. The seed should be planted about November 1st so that the radish will be forming pods while the fruit of tomato is developing and ripening during the following spring. The insects should be gathered by hand.

Leguminous plants, as cowpeas, rattle-box, beggarweed, beans, etc., are much preferred to other plants during the summer and early fall, especially during the pod-formation period. Rattle-box, *Crotalaria urasamoensis,* probably offers one of the greatest possibilities as a trap and propagating crop during the summer. The plant itself is probably not more or perhaps as attractive to the bugs as cowpeas and beggarweed, but the blossoms are very alluring to the parasites. The principal parasite, *Trichopoda pennipes,* is a honey-loving insect and was a constant visitor to the flowers of rattle-box. From 10 to 80 per cent of the specimens of *Nezara viridula* collected on rattle-box bore eggs of *Trichopoda pennipes.* On this account it seems that rattle-box

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should be grown as a propagating plant during summer and thus increase the number of parasites. The long blooming and pod-formation period adds much to the value of the plant as a trap and propagating plant.

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A BLOSSOM DESTROYING BEETLE ON THE MANGO

G. F. MOZNETTE*

When the mango is in bloom it may be visited in swarms by a beetle which when present in considerable numbers may cause serious damage and great concern to the grower. Fortunately up to this time the writer has not observed this beetle to be generally distributed at blossoming time, and may be found in groves in certain localities where others escape. The following year the groves visited the previous year may escape, when others may in turn be visited by this blossom devouring pest. Up to this time this species has attracted attention of growers in the section of Dade County south of Miami, Florida.

This destructive insect was first brought to the writer's attention in February, 1918, when a grower at Larkins, Florida, advised the writer as to destructive work caused by some pest to his mango bloom. Upon examination the writer found the bloom severely eaten, the culprit attacking all portions of the blossom spike, and in many instances completely girdling the same or cutting it off as with a knife, (Plate 1). Usually, however, the beetles confined their attacks to the more tender floral parts destroying the individual floral clusters about the spikes. The beetles were often seen to congregate at the base of the spikes where they gnawed away the outer tissues of the floral spikes, and at other times the beetles gathered at the tops of the spikes destroying everything that came in their path.

During the day numerous freshly eaten floral spikes could be found but the presence of the destructive pest causing the damage could not be detected about the bloom or anywhere on the trees. It was observed, however, that below the trees numerous small entrance and emergence holes were present in the soil. Upon uncovering the soil to a depth of from one inch to two inches a considerable number of small beetles were to be found in a quiescent stage as if playing possum. After a few minutes, however, on exposure to the light the beetles became active and immediately started to dig their way into the soil.

This grove was visited during the evening about eight o'clock of the same day. When among the trees a very familiar sound could be heard as if one were manipulating a hive of bees during the day. On bringing a light gradually up to the bloom great

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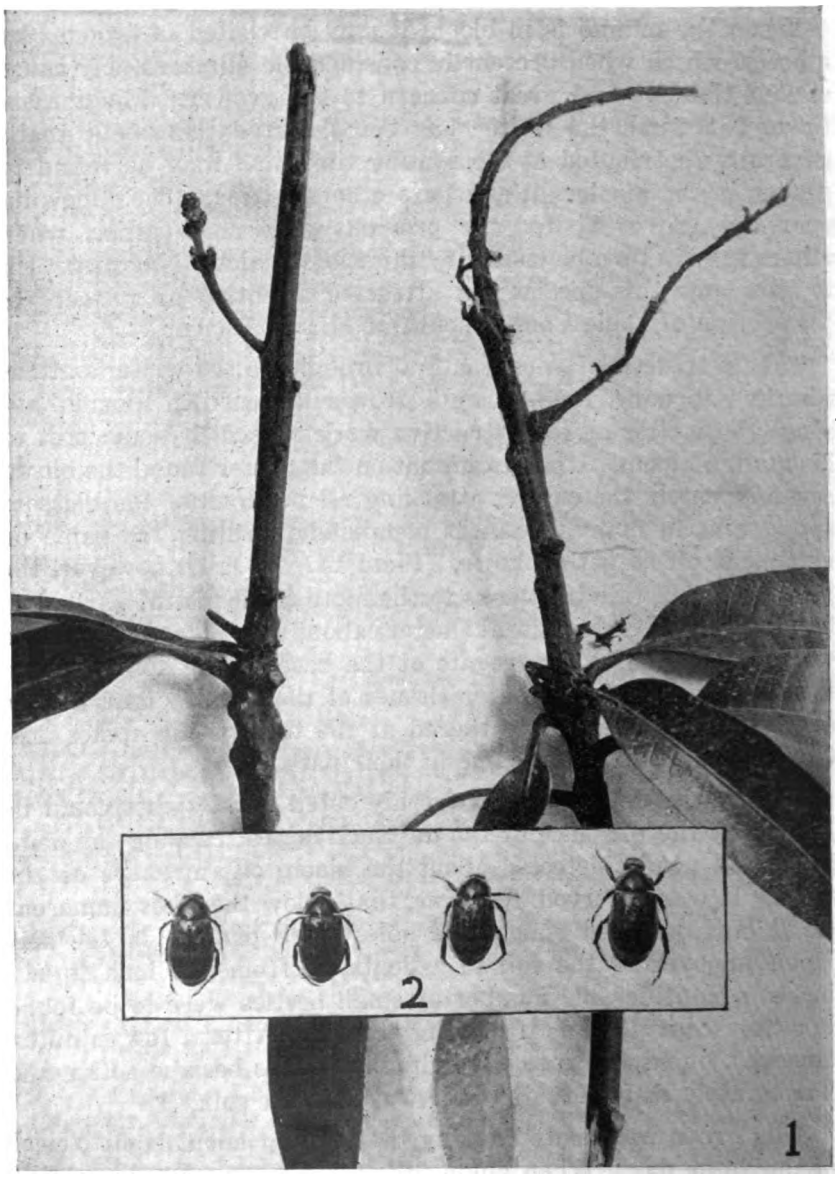

Plate 1.—A blossom destroying beetle of the mango: 1, injury by the beetle to mango blossom spikes; 2, the beetle, *Anomala undulata* Mels.

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numbers of the same beetles found during the day in the soil below the trees were busy at work feeding and flying about the blossom spikes. On bringing the light closer the beetles were seen to drop in great numbers making a noise like rain as they fell upon the dried mango leaves below the tree. To illustrate their abundance at the time these beetles were observed feeding on the mango at Larkins, Florida, it was decided to stretch a large strip of tarpaulin below a tree to see how many adult beetles could be gathered from a single jarring of the tree. The writer gathered as many as could be captured approximately thirteen hundred adult beetles.

The adult beetle (Plate 1, "2") known scientifically as *Anomala undulata* Mels. has a black thorax with a yellowish border; the wing-covers yellowish, with two cross-rows of ill-defined black spots, sometimes almost wanting. They vary in size from a quarter inch to five-sixteenths of an inch in length. However, various variations of the color may occur and the writer has found on a number of occasions nearly black forms. The species is closely related to the so-called May-beetles. Up to this time the writer has been unable to find either the larval form or the host plant upon which it feeds. Judging, however, from similar species the larval form must be closely similar except for their smaller size, to the white-grubs, or May-beetle larvae, not only in general appearance, but more or less in habits also. The larvae probably will be found feeding on the roots of some native or cultivated plant either growing on the pine lands or in the stretches of everglades. In the middle west where this species is also found nothing has been recorded as to the larval habits of this pest.

The writer has also noticed this species feeding on avocado bloom depending, of course, on the time of blossoming and the time the swarms of the beetle occur. The species was also noticed feeding extensively in a bean patch at Redlands, Florida, the beans being practically defoliated. In the middle west it has been recorded as infesting a variety of crops, often to their serious injury. The beetle has been reported from Ohio where it has been found stripping the leaves from plum and pear trees, and also from cherry trees in Illinois. They have been reported as frequently injurious to wheat and other grains in Kansas feeding on the heads when the grain was "in the dough."

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CONTROL

The best means of control has been found to be spraying the blossom spikes with a poison. At the time the mango is being sprayed in the bloom for the Colletotrichum blight which attacks the blossom a combination spray may be used to good advantage. By spraying with two pounds of either powdered arsenite of zinc or arsenate of lead to fifty gallons of the diluted Bordeaux mixture the grower will find that the beetles will be readily killed or the spray will serve as a preventive measure causing the beetles to seek new feeding grounds. The Bordeaux mixture is generally used at a strength of 3-4-50 with the addition of two pounds of soap preferably the resin-fish-oil soap. The soap will cause the spray to spread much better than if it were not incorporated in the combination spray. After the Bordeaux mixture is made and in the tank the resin-fish-oil soap is added after which the particular poison used against the beetles is placed in the tank. It is essential where the powdered arsenate of lead or arsenite of zinc are used, that the spraying outfit be fitted with a good agitator as the poison has a tendency to settle rapidly to the bottom of the spray tank. The spray should be directed at the blossom parts particularly as the beetle does not attack the dormant foliage, and very little if any new growth is present on the mango at the time of blossoming.

PAPAYA LEAF BLIGHT*

H. E. STEVENS

A leaf blight of the papaya (*Carica papaya* Linn.) has recently been reported to the State Plant Board from St. Cloud, Fla. It was learned from the owner of the infected plants that the disease first appeared this year on his place and spread very rapidly The affected leaves of plants attacked soon begin to dry up at the edges and appear as if they had been near a fire. The disease was also observed on some of his neighbors' plants. He further stated that there had not been a papaya plant on his place for the past three years that he had not grown himself, so the disease was evidently brought onto his premises by means of some agent as a carrier. It probably came from one of his neighbors. It is not evident at the present time just how and when the disease was brought to St. Cloud.

Pucciniopsis caricae Earle.

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This is not a new disease as it has been previously reported from Porto Rico, Cuba, British Guiana and Sanibel Island. Fla. This appears, however, to be the first report of its presence on the mainland of Florida, and it might prove to be a serious pest to papaya plants in the southern part of the State should the disease become widely distributed.

While papaya growing is of minor importance at the present time, still there are many persons who grow them for family consumption, and those who are interested in the production of papayas should guard as far as possible against the introduction of this disease into any of their plantings.

Leaf Blight or Leaf Spot is a fungus disease caused by *Puccinioopsis caricae*. Specimens of this disease were first collected by S. W. Tracy (1) on Sanibel Island in 1901. It was again reported from Porto Rico in 1903 by Earle (2) and later by Stevenson (3) who states at times it is a serious pest causing practical defoliation of the plants affected. We also have a specimen of the disease in the Experiment Station Herbarium collected in Cuba by C. F. Baker in 1906. Brancroft (4) includes *Puccinioopsis caricae* in a list of fungi reported from British Guiana in 1918. While the fungus has been known for some time and frequently observed in different countries it has been considered more or less of minor importance. However, we do not know just how it might behave under our Florida conditions and it would not be wise to experiment with it along these lines.

Appearance of the Disease

The disease is striking, and easily recognized by the black pustular spots on the under surfaces of infected leaves, suggestive of Sooty Mold. On the upper surfaces of the leaves the infected areas appear as brown circular spots distinctly outlined. The spots are usually small varying from ⅛ of an inch to mere dots. From a few to several hundred spots may be present on a single infected leaf.

Infections on the under surface of the leaf are represented by black, round masses, called sporodochia, which are raised slightly above the leaf tissue. The small, brown, septate spores of the fungus are found abundantly in these black masses and it is by

(1) Earle, S. F. Bul. N. Y. Botanical Garden, Vol. 2, No. 7, p. 340.
(2) Earle, S. F. Ann. Rept. Porto Rico Expt. Sta. 1903, p. 467.
(3) Stevenson, John A. Ann. Rept. Porto Rico Ins. Sta. 1916-1917, p. 90.
(4) Brancroft, C. K. Jour. Board Agric. British Guiana 11:47-57, 1918.

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means of these spores that the disease is spread. They may be blown by the wind or carried by insects over a considerable area.

Severe attacks of the disease will cause defoliation of the plants resulting in death or a very much weakened plant.

CONTROL

Very little attention seems to have been given this disease especially in regard to control measures, and such recommendations as can be suggested at the present time are only tentative.

If the disease is discovered in time it can probably be easily controlled by the use of Bordeaux Mixture. Three or four sprayings at intervals of ten days to two weeks apart with 3-3-50 Bordeaux Mixture should put down a mild attack. In this case the object should be to keep the slightly infected leaves covered with the Bordeaux to kill any spores produced, and the new leaves well protected during that period to prevent new infections. Both under and upper sides of the leaves should be thoroughly covered with the Bordeaux Mixture. In cases of severe attacks all of the older infected leaves should be removed and destroyed. The remaining foliage should be thoroughly sprayed with 3-3-50 Bordeaux at weekly intervals, until the new leaves that develop are entirely free from infection. If the badly infected plant is a young one it will be more economical to destroy it and start with a healthy plant.

Seedling plants should be closely watched especially if they are grown in the vicinity of old plants carrying the disease. In such cases frequent applications of Bordeaux Mixture will be necessary to protect the seedlings from the disease.

When the Leaf Blight appears efforts should be made to eradicate it as soon as possible.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

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F. M. O'BYRNE.....*Nursery Inspector*
FRANK STIRLING.....*General Inspector*
J. H. MONTGOMERY.....*Quarantine Inspector*
H. E. STEVENS.....*Consulting Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING MARCH 31, 1920.

Citrus grove trees inspected	1,909,863
Citrus nursery trees inspected	7,868,270
Inspectors employed	104
New properties showing infection	0
Total properties showing active infection	0
Grove trees found infected	0
Nursery trees found infected	0
Counties in which active infections were found	0

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,727
Nursery trees found infected since May, 1914	342,254
Number properties infected to March 31, 1920	481
Properties declared no longer "danger centers"	479
Properties still classed as "infected" March 31, 1920	2

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The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1920:

1914		1915		1916		1917		1918		1919		1920	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0
		Apr.	408	Apr.	49	Apr.	169	Apr.	2	Apr.	1		
May	108	May	1042	May	338	May	52	May	1	May	1		
June	160	June	772	June	450	June	45	June	10	June	0		
July	275	July	651	July	349	July	39	July	0	July	0		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1		
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0	Sept.	0		
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0		

QUARANTINE DEPARTMENT

REPORT ON INSPECTIONS AND INTERCEPTIONS, ALL PORTS AND STATIONS, FOR THE QUARTER ENDING MARCH 31, 1920.

The Black Fly, *Aleurocanthus woglumi,* Ashby, continues its efforts to gain entrance to Florida. During the quarter just ended it has been intercepted three times on material from Cuba. In two instances it was on citrus and one instance on mango. In connection with the parcel post inspection it was also intercepted, in a mail package from Cuba, on one occasion.

The destructive scale-insect, *Aspidiotus destructor,* Signoret, also continues its efforts to invade Florida. During this quarter it has been intercepted in shipments from Cuba, Porto Rico and the Isle of Pines. In all it has been "stopped" 29 times during the three-month period.

The rind disease of sugar cane has been prevented entry to the State on two occasions; once from Cuba and once from the Isle of Pines.

Another "caller" at our ports was a scale-insect, *Targionia hartii* Ckll. on yam from Georgetown, G. C.

A striking development in connection with the inspection of nursery stock shipments from other states to Florida was the relatively large number of shipments infested with San Jose scale, this pest having been found in 36 shipments during the quarter. Most of these shipments came from the Southeastern States, with some from points as far west as Louisiana and some as far north as North Carolina.

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During the quarter no less than 408 packages and shipments containing injurious insect pests or plant diseases have been prevented delivery to Florida citizens. These shipments contained enough pests, if established, to cause ultimate losses amounting to many thousands of dollars. In fact, it would be impossible to estimate the value of the protection afforded Florida agriculturists by the quarantine service.

A condensed summary of the quarantine inspection work for the quarter follows:

REPORT ON INSPECTION AND ERADICATION WORK FOR THE QUARTER ENDING MARCH 31, 1920

GENERAL SUMMARY

SHIPS INSPECTED:			
From Foreign Ports	745		
From U. S. Ports other than Florida	324		
From Florida Ports	212		
Total		1281	
NUMBER OF PARCELS INSPECTED:			
Arriving by Water:			
Passed	143,452		
Treated and passed	4215½		
Returned to shipper	336		
Contraband destroyed	717½		
Total		148,721	
Arriving by land, express, freight, wagon, etc.:			
Passed	2376		
Treated and passed	63½		
Returned to shipper	56½		
Contraband destroyed	72		
Total		2568	
Arriving by mail:			
Passed	314½		
Treated and passed	20		
Returned to shipper	53		
Contraband destroyed	7½		
Total		395	
GRAND TOTAL OF PARCELS INSPECTED			151,684
Number of parcels on hand pending determination as to final disposition	2687		
TOTAL PARCELS PASSED		146,142½	
TOTAL PARCELS TREATED AND PASSED		4299	
TOTAL PARCELS RETURNED TO SHIPPER		445½	
CONTRABAND DESTROYED		797	
GRAND TOTAL			151,684

BEE DISEASE ERADICATION

REPORT ON INSPECTION AND ERADICATION WORK FOR THE QUARTER ENDING MARCH 31, 1920

Number of apiaries inspected	44
Number of apiaries infected with American foul brood	7
Number of colonies inspected	1,246
Number of colonies infected with American foul brood	24
Number of colonies destroyed American foul brood	24
Number of colonies treated, American foul brood	0
Number of colonies infected with European foul brood	0
Number of colonies treated, European foul brood	0
Number of colonies infected with sacbrood	5

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General Summary

Number of apiaries inspected since July 1, 1919	195
Number of apiaries infected with American foul brood	23
Number of colonies inspected since July 1, 1919	8,951
Number of colonies infected with American foul brood	78
Number of colonies destroyed, American foul brood	78
Number of colonies treated, American foul brood	0
Number of colonies infected with European foul brood	3
Number of colonies treated, European foul brood	3
Number of colonies infected with sacbrood	8

WHITEFLY FUNGUS

E. W. Berger

The Entomological Department of the State Plant Board now has ready for distribution approximately 3,000 pure cultures of the Red Aschersonia and Yellow Aschersonia. A culture consists of the amount of fungus that can be grown in a wide-mouth pint bottle, and is sufficient for starting the fungus in an acre of grove.

The two fungi named are diseases, or parasites, of the common whitefly and the cloudy-winged whitefly, both of citrus. Under favorable weather conditions, plenty of moisture and warmth, these fungi produce such a satisfactory control of these whiteflies that other treatment often becomes unnecessary. Many experienced growers, therefore, like to introduce the fungi into their whitefly-infested groves during the period of summer rains, which is the ideal time to introduce them.

When ordering, growers are requested to send a few dozen leaves for examination in order that we may determine whether to include in the order one or more cultures of the Yellow Aschersonia, regarded by some as more effective against the cloudy-winged whitefly.

The price is 75 cents per culture, approximately the cost of production. TRANSPORTATION CHARGES ARE PAID BY THE PURCHASER.

Remittances should be made payable to "State Plant Board of Florida" (postage stamps cannot be accepted). Address: Entomological Dept., State Plant Board, Gainesville, Florida.

Orders for fungus should be accompanied by remittance, as otherwise same will be sent C. O. D.

Name nearest express office when this is not the same as the postoffice address.

Orders for fungus of one to three cultures will be sent by parcel post only when necessary postage money is included with remittance. Shipping weights: 1 culture, 2 pounds; 2 cultures, 4 pounds; 3 cultures, 5 pounds.

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Vol. IV July, 1920 No. 4

THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

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Published by
STATE PLANT BOARD OF FLORIDA
GAINESVILLE, FLA.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. IV JULY, 1920 No. 4

IMPROVE THE FLORIDA CITRUS VARIETIES

LEO B. SCOTT

I have had the pleasure of attending a number of meetings of Florida citrus growers. On all of these occasions I have talked on one general theme—the need of eliminating some of your worthless sorts of oranges and grapefruit, and the development of the best producing strains within your standard varieties. I am going to continue to talk along these same lines—others will do the same thing—and we are not going to stop talking either until every citrus tree in Florida is bearing a good crop every year of fine quality fruit.

The first meeting of citrus growers which I attended in Florida was the memorable session of the Citrus Seminar, held at Gainesville in October, 1915. Although I was not then familiar with Florida conditions, it did not take me long to realize that your big problem which you had to face was the eradication of citrus canker. How well you have succeeded is shown in the monthly reports issued by your Plant Commissioner. The work of the State Plant Board and the Bureau of Plant Industry has meant millions to Florida, in fact, the saving of the citrus industry, and I am thankful in saying that all the citrus growers of this state realize it.

During 1915-16 we attended several meetings of fruit growers in different parts of the state, and discussed, both formally and informally, the subject of Florida's citrus varieties. At the Seminar at Gainesville in 1916 a committee of representative citrus growers and nurserymen was selected, who agreed that in their judgment the following short list of orange varieties should be developed as the standard oranges for Florida. These in order of maturing, were Parson (Parson Brown), Homosassa, Pineapple, Valencia and Lue (Lue Gim Gong). The committee's report was accepted by the growers assembled there. No action was taken on the question of grapefruit varieties.

In 1916-17 my associate, Mr. E. D. Vosbury, was stationed in Florida in charge of the subtropical fruit production investigations of the United States Department of Agriculture in this state. A portion of his duties consisted in securing data on

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grapefruit varieties, and assisting growers in inaugurating systems of securing individual-tree performance records in their groves. The freeze of February, 1917, interfered with our work. In many orchards the fruit was injured to some extent, and growers, feeling the records would be of little value that year, discontinued them.

Next came the great war and during this period the labor situation was acute. If the ordinary routine duties, such as cultivation or fertilization of the grove, or even the picking of the fruit, were properly attended to the grower was satisfied. It was not a time to suggest changes. Although we attended some meetings in Florida during this period, as far as our subtropical fruit investigations in this state were concerned we simply "marked time".

With the ending of the war conditions have changed. The labor situation will not be the same next year as last. The demand for citrus fruits is bound to increase from year to year. Oranges, grapefruit, lemons and limes are looked upon in many places as actual necessities. In many homes in the North citrus fruits appear on the menu every day in the year. As more people become accustomed to using citrus fruits the popular taste will become more discriminating. The northern buyer will purchase the clean, bright fruit which has some distinctive characteristic by which he can readily identify the variety, in preference to dirty, sooty fruits which have no distinctive characteristics, and which are packed in boxes containing both seedling fruits and those of budded varieties.

How will the progressive grower meet this situation, which I believe marks a new era in the development of the citrus industry in this state? By better grove sanitation? True, improved methods of cultivation, fertilization and pruning should be used. Better spraying or fumigation should be practiced. By greater care in handling? Yes, even more care should be used in picking and packing the fruit than in the past. By better advertising? Again the answer is in the affirmative. All of these factors are vitally important to the development of the industry. It seems to me that there is one other factor on which all the others rest, and which we are prone often to overlook, and this is a standard uniform product.

The success of the California citrus industry has been due to three things: (1) Cooperation among the growers, (2) extensive and comprehensive advertising of their product, and (3) the

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presence of only a few varieties which the purchaser quickly learned to know.

California has two orange varieties, the winter orange, the Washington Navel, and the summer fruit, the Valencia. The purchaser soon learned to know these varieties. Although the fruits are always sold in boxes labeled Washington Navel or Valencia, the purchaser knew the Washington Navel fruits by their outer trademark, the navel character, and he knew the other orange must be a Valencia because it was *not* a navel.

Florida oranges are marketed simply as Florida oranges. That statement may be too sweeping, for occasional boxes are seen marked Pineapple or Valencia. More often, however, Pineappels will be packed in the same box with seedlings, and the innocent purchaser has absolutely no guarantee of what he is getting.

The action of the committee at Gainesville is a start. It gives growers and nurserymen a basis on which to work, but it is only a beginning. Do not misunderstand me. The action of the committee does not mean that the list can not be revised from time to time. However, no new varieties should be added to the list, or substituted for any of the standard ones, unless (1) they are annual producers of heavy crops, (2) the fruit must have some distinctive or superior characteristic in time of ripening or in flavor, and (3) the fruit should have some external charactertistic by which it can be easily identified by the purchaser.

I believe a registry committee, not only for citrus fruits, but for all other fruits, should be an important committee of your State Horticultural Society. I would like to call your attention to the action of the California Avocado Association. Three years ago the avocado varietal situation in that state was somewhat comparable to your problem with citrus fruits. About 140 varieties of avocados had been introduced, named, and described, and were being sold by the nurserymen. We began an investigation of the varietal situation and reported to the directors of the association from time to time. Others in the state conducted similar investigations.

After the investigations had been conducted for about a year a report was made to the registration committee of the association, who carefully discussed the merits of every variety, and finally agreed on a list of eight which they recommended for planting in California. Think what a reduction in one year's time,* from 140 to 8! However, they specified that if a new

*May 15, 1920. The variety list has been further reduced.

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variety should be developed which has characteristics far superior to some of the existing ones, and if, in their opinion, its performance justified, it could be added to the list or substituted for some of those which were previously recommended.

Such a plan could be followed with your citrus varieties. However, even when you reduce the number of your varieties, and even when you market your fruit as varieties and not simply as oranges and grapefruit, your problem is only partially solved. Not all the trees within the variety bear the same type of fruit. In the same grove we find marked differences among individual trees. You have got to go farther than the variety; you will have to develop the best strain within each variety. By that word "strain" I mean a collection of individuals within a horticultural variety, which, while retaining the general characteristics of the variety, have such clear-cut characteristics of their own that they can be easily distinguished from other groups of individuals within the variety. How have these strains originated? By bud variation. In the Washington Navel orange alone we have found thirteen strains; in the Valencia twelve, and in the Marsh grapefruit five. Corresponding variations have been found in other varieties. The strains are found occurring as whole trees, as limb sports, and as individual fruit sports; some are worthy of propagation, many are not. For a full description of these strains I would refer you to United States Department of Agriculture Bulletin No. 623, "Citrus-Fruit Improvement: A Study of Bud Variation in the Washington Navel Orange"; No. 624, "A Study of Bud Variation in the Valencia Orange"; and No. 697, "A Study of Bud Variation in the Marsh Grapefruit".*

Although some of the detailed studies of variations in citrus varieties have been conducted in California, nevertheless you have similar variations within your varieties. Even within the standard strain you will find differences in production of individual trees, which in many cases are so pronounced as to mean an actual loss on the whole grove to the owner. One tree bears eight boxes of fruit, the one next to it one. These differences are found to be consistent from year to year. No matter how much care and attention you give the one-box tree you cannot bring it up to the level of the eight. The one is inherently a

*May 15, 1920. Two other bulletins in this list soon will be available, "Citrus-Fruit Improvement: A Study of Bud Variation in the Eureka Lemon", and "Citrus-Fruit Improvement: A Study of Bud Variation in the Lisbon Lemon".

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heavy producer, the other is not. You will also find the eight-box tree bears fine quality fruit, the other anything but fancy fruit.

In all our work with citrus varieties we have generally found quantity is correlated with quality. The high producer as a rule also has the best quality fruit.

In one lemon orchard in California which came under my observation ninety-five per cent of the trees were *shade* trees, one of the unproductive strains of the Eureka lemon. Fine, healthy, vigorous growing trees, but as the name of the strain indicates, more suited for an ornamental shade tree than for an orchard. I am glad to say, however, that this orchard has since been top-worked to the ideal productive strain of the Eureka lemon.

How are you going to find these slacker trees, these drones in your orchard? The only efficient way is by securing individual-tree performance records.

By the term "performance record" is meant an actual record of the amount and quality of fruit borne by each individual tree in the orchard for a series of years.

As a result of the investigations which the Department of Agriculture has been carrying on for a number of years in the improvement of citrus fruits commercial individual-tree performance records are now being secured on thousands of acres of citrus trees in California and in a number of groves in Florida and Alabama.

For a complete description of a practical and established method of securing individual-tree performance records I would refer you to the United States Department of Agriculture Farmers' Bulletin No. 794, "Citrus-Fruit Improvement: How to Secure and Use Tree Performance Records".

Three important factors are involved in the securing of accurate individual-tree performance records. These are, first, a definite system of individual tree numbering; second, a definite system of individual tree picking; and third, the recording of the individual tree records in permanent record forms.

In order to effectively secure commercial individual-tree performance records it is absolutely necessary that the system of tree numbering which is used be a very simple and permanent one. A plan which has proved very practical under California conditions is to divide the orchard into a number of blocks. Each individual tree is given its own tree number and this number is painted on the tree trunk with white lead paint. This

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tree number consists of the block number, row number and the number of the tree in the row, thus: Tree 4-8-16.

4
8
16

instantly locates that tree as being in block 4, row 8, and the 16th tree from the end of the row, always numbering from some given point. Where such a system of tree numbering has been practiced it has been found that in a very short time unskilled laborers can be trained to perform this operation with the result that the cost incidental to the numbering of citrus trees varies from 40 to 50 cents per acre.

The advantages of such a system of tree numbering are at once apparent. No matter how large an acreage, there never will be a duplicate tree number.

In addition to the value which the individual-tree number will have in the securing of performance records, it also serves as a means of identification for the individual tree in a number of other ways. For instance, if a tree is found badly affected with scale the tree number can be jotted down in a notebook and that tree can be given instant attention. Tree numbering probably is one of the most essential points in the systematizing of grove and orchard operations.

If, because of weather conditions or the peculiar branching habit of trees, as is common in many old Florida groves, it may not be advisable to paint the tree number on the tree trunk, in this case the tree number could be stamped on an aluminum label, the label attached to a long copper wire, the wire attached to a copper nail and this nail driven into one of the main branches or tree trunk. Some modification of these two methods of tree numbering will be applicable to citrus conditions in any grove.

A second important factor in the securing of individual-tree records is that each tree be picked separately. In large citrus groves it will be necessary to have one man for each row. He should be assigned to the first tree in that row, pick all the fruit from that tree and assemble it in boxes at the base of the tree before proceeding to the second one. In large picking crews it will prove expedient in order to conserve the picker's time, to have one man whose sole duty is placing of the empty boxes under the individual trees. After the performance records are secured, this man will carry the full boxes to the wagon and help load the wagon.

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TABLE 2—ANNUAL CITRUS TREE RECORDS

Year..... Variety.....
Block No..... Grove .....
Row No..... Location.....

	PICKING DATES							
	FIRST PICK			SECOND PICK				
Tree No.	Boxes	Part Boxes	Grade	Boxes	Part Boxes	Grade	Total	Notes
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
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28								
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30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

In large picking crews one man will have to be detailed whose sole activity will be the recording of individual performance record data. In smaller crews the picking foreman probably can secure this information himself. This man should be provided with suitable field note books for securing these records. Before recording the amount of fruit borne by any tree he should

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see that the boxes are properly filled and should not record a full box unless the box is filled with fruit level with the top.

Table 2 shows an actual citrus tree record which can be used in securing records of individual orange and grapefruit trees' production. Space is provided in the heading of the blank for recording the year, block number, row number, variety, name of grove and location of grove.

As in many sections at least two picks are made of oranges and grapefruit each year a place is left on the blank for recording the amount and quality of fruit obtained at each pick. Space is provided for the recording of the data from 40 trees on each page. Probably never more than 40 trees will be found in any given row. In the first column the number of full boxes borne by the tree is recorded. In the second column is a place for recording the fractional box remaining, if there is any, from each tree. For all practical purposes this can be expressed either as 1-4, 1-3, 1-2, or a similar fractional term. While it will not be practical to grade the fruit closely in the field, it will be possible by a very hasty examination to determine, in a general way, the quality of fruit borne by each tree. In the column marked "grade" the quality of each individual tree can be designated by the letters A, B, C or D. If the tree produces a noticeable number of sports, freaks, or off-type fruits, this fact can be noted in the column headed "notes".

If care is used in the field in recording the individual-tree records there will be no need of transferring these records to any other form. At the end of the picking season, the individual tree records can be detached from the book and placed in suitable filing cases so that the records of each tree can be filed in one place.

The chief objection raised by growers who are not securing individual-tree performance records is the excessive cost which would result in the introduction of such an operation in their groves. On the contrary, it has been found where systems of securing commercial individual-tree records have been introduced in citrus groves that these records can be secured at practically little or no expense. As previously indicated, in discussing picking operations, it is necessary to reorganize in many cases the established plan of operations. In California citrus groves, for instance, the old method of picking fruit was to have a box row. In this box row the empty boxes were placed and here the wagons were loaded after the boxes had been filled. Four rows were

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picked each side of the box row. It was necessary after a picker had filled his sack with fruit to walk from the tree over to the box row and empty that sack of fruit. Under the new system of picking a box row is still used. One man, as previously indicated, scatters the empty boxes under the tree, the picker assembles his fruit in boxes under each individual tree. A second man or "secretary" secures the performance records of each individual tree's production and he, with the first man, carries the boxes over to the box row and loads the wagons. The pickers, however, as soon as they finish one tree, go right to the next one in that row, and it has been found in large picking crews that they actually pick enough more fruit in a day when using this new system to more than pay for the two extra men's time; so the actual securing of the records is accomplished with practically little or no additional expense. The heaviest item of expense in securing tree records is the initial one of numbering the trees.

At least two years' records, preferably longer, should be secured before a tree is actually condemned as being a non-producer. At least four years' records should be secured before any budwood should be cut from the tree for use in nursery propagation, or in topworking unproductive trees.

After a grower has secured individual tree records for a series of years you will then ask,—What is the next step after a large number of unproductive trees have been located? If the trees are in an unhealthy condition, and their lack of production may be attributed to this fact, the only practical thing to do is to remove the diseased trees and replant with younger stock which you know has been propagated from fruit bearing wood taken from ideal trees of a standard strain of an established horticultural variety. If the old trees are in a healthy, vigorous condition, and to all outward appearances should be bearing profitable crops, and you find this condition holds true for several years, you are then practically safe in assuming that they are inherently unproductive, or slackers. The trees have already established a good root system and it would seem almost criminal to remove such trees if there is any other practical way to utilize them. We have found in our California investigations that unless the trees are very old and the bark does not work easily that it is much better to topwork or rebud the unproductive trees, using budwood from selected productive trees of standard varieties, than to remove the unproductive ones and replace with new stock. Three or four of the main branches can be used for topworking,

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the buds inserted in much the same way as you would follow in nursery propagation. If the wood is too old to work easily the trees can be cut back and sprouts allowed to grow, and the next season the buds can be placed in these sprouts. We have found with oranges, grapefruit and lemons in California that trees thus topworked began to bear some fruit the second year after working, to bear quite heavy crops the third year, and might be said to be in commercial production the fourth or fifth season.

In rebudding or in nursery propagation we only recommend the use of fruit bearing wood with the fruits attached. Our reason for saying this is, when you have secured your individual-tree records for a series of years, and have found that certain trees in the orchard bear consistently heavy crops of fine quality fruit, you will also find on examining some of these trees that there are occasional small limbs which bear fruit which is not typical of the variety. It is undoubtedly by using budwood from limbs such as these that many of the inferior strains within our standard varieties have originated in the past. In order to safeguard the possibility of propagating a worthless or undesirable strain we believe that the grower or nurseryman can well afford to sacrifice the fruits which are at the end of the bud sticks. By taking the fruits themselves as an actual guide he has then an additional guarantee for believing that the buds on that stick will produce the same type of fruit.

The first instance of extensive topworking with citrus trees which came to my attention was on the Chase Plantation at Corona, Cal., in 1911. Although no individual-tree performance records had been secured in that orchard at that time a careful survey of the orchard was made and three thousand unproductive or shade tree Eureka lemons were located. At the same time a careful tree census was made of all the other lemon trees in the orchard, and a number were picked out which appeared to be standard Eurka, and which bore very heavy crops, in contrast to the light producing character of the shade trees. Buds were taken from these superior producing trees, placed in the branches of the shade trees, and inside of two years every one of those trees thus topworked was bearing a considerable amount of fine quality fruit, and in the third year were all bearing good commercial crops. There was not a single failure. Since then thousands of trees have been topworked with selected buds in California orchards. As far as I know we have yet to hear of

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a single case where there has been a failure and buds have not come true to the strain desired.

Although many California growers are securing individual-tree records in their own groves, there has been such a heavy demand from other growers, and from nurserymen as well, for selected performance record buds that it was practically impossible to comply with the demand. The California Fruit Growers Exchange, which is a cooperative, non-profit, marketing organization, including between seventy and eighty per cent of the citrus growers in that state, recognizing the great value to the industry of having every tree within a variety producing practically the same type of fruit, organized in the Supply Company of the Exchange a department which is known as the Performance Record Bud Supply Department. This department furnishes to growers and nurserymen, whether they are members of the Exchange or not, buds from performance record trees of any of the standard citrus varieties grown there. Buds are only cut from trees where records have been secured for at least five or six years. In addition, the department, looking to the future, is starting individual-tree records in a number of groves so that in a few years they will be able to furnish practically all the buds which are used in the state. Buds are furnished to nurserymen and growers at a cost of five cents a bud to Exchange members, and six cents a bud to non-members. In the report of the manager of the Supply Company for the year ending September 1, 1918, it was shown that in this period of unusual depression, when there were practically no new plantings, and all the budwood sold could be directly charged to topworking, between two hundred and three hundred thousand buds were furnished by the Supply Company to citrus growers in California. The Bud Supply Department not only was operated at cost during the first year of its existence, but actually returned quite a little profit to the organization.*

I believe you should have some similar organization in Florida. I have urged this in the past. Some growers have thought the time was not yet ripe for such a public service in Florida. If, however, the growers of California, with their small number of varieties, believe such a service is necessary to successfully develop their industry, it seems to me all the more reason why you, with your greater number of varieties, should have a similar service.

*May 15, 1920. It is estimated that during the present year, 1920, approximately a million record buds will be handled through this organization.

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This service should be open to every person interested in citrus growing in the whole state. I have talked with the officials of the Florida Citrus Exchange, with Professor Newell and his associates of the Plant Board, and with Professor Rolfs, and all are agreed that the logical place for such a public service in Florida is in the Florida State Experiment Station. If the growers demand it the work can be started.

In the neighboring state of Alabama there is a small citrus industry. In Baldwin and Mobile Counties the Satsuma orange is raised. Dr. Tanaka, of the office of Crop Physiology and Breeding Investigations, United States Department of Agriculture, has found in his studies in Japan that the Satsuma orange in reality is not a true variety but a group, and that within this group there are a number of important varieties. Surveys conducted by Dr. Tanaka and myself in Alabama have shown that three of the Japanese varieties have already been introduced and are now shown in the Alabama orchards.

In cooperation with the Alabama Horticultural Society, and the State Experiment Station at Auburn, surveys have been made of practically every bearing grove in the two counties, and the variety of Satsuma borne by the different trees has been noted. In addition, we have determined which variety was carried by the leading nurseries in the South which have specialized in this particular fruit. For instance, one of the leading nurseries handle only the Owari, which in Alabama matures the latter part of October or the first of November. This fruit is flat, thin-skinned, depressed at both the blossom and stem end, and has characteristic leaves and habit of growth. Other nurseries carried the Ikeda variety, the fruits of which are spherical, not depressed at either end, thicker skinned, and mature about a month later than the Owari. All the nurserymen now operating in Alabama are only securing budwood from orchards which the Alabama Horticultural Board will certify are either Owari or Ikeda. The other variety, Zairai, does not seem worthy of propagation. In addition to this some of the growers are now securing individual-tree records so that in a few years the nurserymen will be able to get their budwood from the best producing trees within these varieties.

I mention this particular instance in a neighboring state which shows how the question of selection, if properly handled, can be of great value to an industry.

I have every confidence in the future of the Florida citrus

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industry. I do not believe, however, that you are going to make the development which you should make unless you begin at once to reject many of your worthless varieties, and to develop only the best producing strains within your standard varieties. I see no reason why the Florida citrus growers can not do just as much as the California citrus people, as the avocado growers in that state, or the Satsuma growers of Alabama. The office of Horticultural and Pomological Investigations of the United States Department of Agriculture stands ready at any time to assist you in this work.

FUMIGATION AT FLORIDA PORTS

J. H. MONTGOMERY

The farmers and fruit growers of Florida are probably not aware of the fact that they are being afforded exceptional protection against invasion by plant pests from foreign countries at the entry ports of Key West and Port Tampa. Complete fumigating plants have been built at both of the ports referred to and all commercial offerings of fruit and vegetables from foreign ports are subjected to treatment with hydrocyanic-acid gas. The Key West plant has a capacity of 700 crates and the Port Tampa plant a capacity of about 500 crates. These plants are complete in every detail, even to having exhaust fans to quickly clear the rooms of gas after fumigation.

The Plant Board inspectors, who are also collaborators of the Federal Horticultural Board, formerly had to inspect all offerings of horticultural products. This was found to be an arduous, as well as an unsatisfactory procedure. Exhaustive investigations were conducted by both state and federal experts as to the effects of fumigation of fruits and vegetables, with the result that it was decided to put fumigation of commercial shipments into practice.

The fumigating plants are operating to the entire satisfaction of all parties concerned. The materials subjected to treatment are not injured, the work of the inspectors is facilitated, and delivery of imports is greatly expedited. The results of the work at Key West and Port Tampa have been proven so satisfactory that it is the hope of State Plant Board officials that fumigating plants of adequate size and equipment to meet the necessities will, at no distant date, be in operation at each of the ports of entry in Florida.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.....*Editor*

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H. E. STEVENS.....*Consulting Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING JUNE 30, 1920

Citrus grove trees inspected	1,438,051
Citrus nursery trees inspected	16,419,006
Inspectors employed	102
New properties showing infection	0
Total properties showing active infection	0
Grove trees found infected	0
Nursery trees found infected	0
Counties in which active infections were found	0

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,727
Nursery trees found infected since May, 1914	342,254
Number properties infected to June 30, 1920	481
Properties declared no longer "danger centers"	479
Properties still classed as "infected" June 30, 1920	2

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The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1920:

NUMBER OF GROVE TREES FOUND INFECTED WITH CANKER, PER MONTH, SINCE THE WORK BEGAN IN MAY OF 1914

1914		1915		1916		1917		1918		1919		1920	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0
		Apr.	408	Apr.	49	Apr.	16	Apr.	2	Apr.	1	Apr.	0
May	108	May	1042	May	338	May	5	May	1	May	1	May	0
June	160	June	772	June	450	June	45	June	10	June	0	June	0
July	275	July	651	July	349	July	39	July	0	July	0		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1		
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0	Sept.	0		
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0		
	4327		6715		2294		372		15		4		

QUARANTINE DEPARTMENT

REPORT ON INSPECTIONS AND INTERCEPTIONS, ALL PORTS AND STATIONS, FOR THE QUARTER ENDING JUNE 30, 1920

During the quarter ending June 30, 1920, inspectors of the State Plant Board stationed at the several ports of entry in Florida intercepted one hundred and eight shipments of infested or infected horticultural material from seven foreign countries. This material was of course safely disposed of. A number of the shipments were carrying pests which are not now known to be present in the United States. Other shipments were found to be infested or infected with pests which have neither become firmly established nor widely spread in this country. A statistical statement of the work of the Port Quarantine Service follows:

SHIPS INSPECTED:

From foreign ports	716	
From U. S. Ports other than Florida	333	
From Florida ports	206	
Total		1,255

NUMBER OF PARCELS INSPECTED:

Arriving by water:

Passed	88,767	
Treated and passed	16,035	
Returned to shipper	576	
Contraband destroyed	368	
Total		105,746

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Arriving by land, express, freight, wagon, etc.:			
Passed	4,265		
Treated and passed	8		
Returned to shipper	2,917		
Contraband destroyed	25		
Total		7,215	
Arriving by mail:			
Passed	596		
Treated and passed	8		
Returned to shipper	42		
Contraband destroyed	9		
Total		655	
GRAND TOTAL OF PARCELS INSPECTED			113,616
Number of parcels on hand pending determination as to final disposition	67		
TOTAL PARCELS PASSED	93,628		
TOTAL PARCELS TREATED AND PASSED	16,051		
TOTAL PARCELS RETURNED TO SHIPPER	3,535		
CONTRABAND DESTROYED	402		
GRAND TOTAL			113,616

BEE DISEASE ERADICATION

REPORT ON INSPECTION AND ERADICATION WORK FOR THE QUARTER ENDING JUNE 30, 1920

Number of apiaries inspected	171
Number of apiaries infected with American foul brood	14
Number of colonies inspected	6,056
Number of colonies infected with American foul brood	25
Number of colonies destroyed, American foul brood	25
Number of colonies treated, American foul brood	0
Number of colonies infected with European foul brood	2
Number of colonies treated, European foul brood	2
Number of colonies infected with sacbrood	630

GENERAL SUMMARY

Number of apiaries inspected since July 1, 1919	366
Number of apiaries infected with American foul brood	37
Number of colonies inspected since July 1, 1919	15,007
Number of colonies infected with American foul brood	103
Number of colonies destroyed, American foul brood	103
Number of colonies treated, American foul brood	0
Number of colonies infected with European foul brood	5
Number of colonies treated, European foul brood	5
Number of colonies infected with sacbrood	638

It is reported, on good authority, that the sweet potato weevil is doing severe damage in Jamaica, the farmers having found in many instances that the sweet potato crop is so badly injured by this pest that the crop is not worth the work of harvesting. An excellent argument for prosecuting vigorously the work of eradicating this insect from Florida.

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